PROVINCE OF ALBERTA

A REPORT ON THE REHABILITATION OF THE DRY AREAS OF ALBERTA AND CROP INSURANCE

1935-1936

Published under the direction of
HON. W. N. CHANT
Minister of Agriculture

EDMONTON: Printed by A. Shnitka, King's Printer
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To: THE HONOURABLE MINISTER OF AGRICULTURE, W. N. CHANT.

The following committee, namely,

O. S. LONGMAN, B.S.A.,	Field Crops Commissioner (Chairman);
A. E. PALMER, B.Sc., M.Sc.,	Asst. Supt., Experimental Farm, Lethbridge;
LAURANCE KOOLE,	Farmer, Monarch;
M. L. FRENG,	District Agriculturist, Lethbridge;
DR. F. A. WYATT, B.S.A., M.Sc., Ph.D.,	University of Alberta, Edmonton;
A. C. B. GRENVILLE,	Farmer, Morrin;
J. J. STRANG,	Farmer, Claresholm;
E. L. GRAY, B.S.A.,	General Manager, Eastern Irrigation District, Brooks, Alberta;
DONALD CAMERON, B.Sc., M.Sc.,	University of Alberta (Secretary),

was appointed by the former Minister of Agriculture, Honourable F. S. Grisdale, to investigate and report upon the problems confronting the drought area of Alberta, these investigations to give due consideration to:

(*a*) Causes responsible for soil drifting;
(*b*) Methods of controlling soil drifting;
(*c*) Farm management practices suitable for the dry areas of the Province;
(*d*) Live stock policy suitable for the drought area;
(*e*) Conservation of feed and water supplies;
(*f*) Educational and demonstration programmes for the drought area;
(*g*) Crop insurance.

The Committee was further instructed, by a resolution passed by the Legislative Assembly of Alberta on April 26th, 1935, as follows:

"Whereas in every year many farmers in different localities suffer grievous crop losses through climatic conditions such as drought, frost, hail, etc.; and

"Whereas these conditions, in a great many cases, have resulted in want and suffering, and have compelled these farmers to seek relief for feed, seed, and also supplies for the home; and

"Whereas in the districts so affected, the whole business structure suffers as a result of these losses by the farmers, and the consequent lack of purchasing power; and

"Whereas the Government, realizing the necessity of investigating every means whereby these conditions may be remedied, has appointed a Committee to study the problems pertaining to drought, including crop insurance; therefore be it

"Resolved, That in the opinion of this Assembly, the above Committee should continue their investigations and report their findings and conclusions to the Legislature at its next session."

Therefore, on behalf of the above Committee, I take pleasure in presenting for your consideration the following report: Part I entitled, "The Rehabilitation of the Dry Areas of Alberta," and Part II, "Crop Insurance."

O. S. LONGMAN,
Chairman.

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PART II

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On behalf of the Committee, I wish to express our grateful appreciation for the very valuable assistance and services rendered by the Secretary, Mr. Donald Cameron, M.Sc., University of Alberta, who was responsible for the accumulating and compiling of the information and data which has formed the basis of this report.

We also gratefully acknowledge information and assistance given by Dr. W. H. Fairfield, Superintendent, Dominion Experimental Farm, Lethbridge, and wish to thank any others whose assistance in any way, directly or indirectly, has helped the Committee compile its report.

O. S. LONGMAN,
Chairman.

PART I

The Rehabilitation of the Dry Areas of Alberta

The history of agricultural settlement in Western Canada and particularly that part of the prairie plains that has come to be known as the Drought area, is of such recent origin that it is very difficult to view the problems that have arisen out of that more or less unplanned settlement in their proper perspective. We are too close to the actual happening and the outlook of too many individuals is likely to be coloured in the light of their own experience, favourable or otherwise. It will be agreed, however, by unbiased observers that the opening of large tracts of land in Canada and the United States, and the development of large scale methods of cultivation during the last 50 years, have really been an extensive and extravagant exploitation of the agricultural wealth of the land with little or no attempt to conserve capital in the form of the soil itself. It has taken us almost 50 years in Canada to realize that our resources in agricultural land are not unlimited, and with that realization has come recognition of the need not only of conserving what we have, but also of reclaiming some of our resources which are in the process of being dissipated through a faulty system of agriculture and improper utilization of land.

The problem of land utilization to-day is one that is giving grave concern to statesmen, farmers and economists alike the world over. It is essentially a problem of the twentieth century and particularly of the post-war years. As long as new worlds with vast areas of rich virgin soil were being discovered and opened up for settlement very little thought was given to the question of conservation and adaptation of soil resources, and consequently many of the policies, or lack of policies, followed have been short sighted and wasteful—wasteful of the land itself and of human life and energy.

The area brought under the plow in the past century has been as great as that in all the centuries that have gone before, and during the past 35 years it has been two-thirds as great as in the 70 years preceding.

Prior to 1850, agriculture had developed mostly in the forested regions of the world where streams or springs were abundant, or in desert areas reclaimed by irrigation. The vast sub-humid and semi-arid grass land areas were the grazing grounds of the nomads of the world, and there are people to-day who seriously suggest that these areas should revert to their former use. Most of the expansion of crop area during the last 75 years has occurred in these grass land areas of the world, notably the prairie plains of North America, the Russian Steppes, the Argentine Pampas, and latterly some expansion has taken place in China and India. The utilization of these vast new areas has been made possible by the development of modern farm machinery, improved varieties of crops, better agricultural technique, and modern transport facilities. The chief marketable produce of these grass land areas is cereals, mainly wheat, and this fact must be kept in mind in considering the whole problem of land use in our drought areas.

FACTORS WHICH GOVERN THE USE OF LAND IN A PARTICULAR COMMUNITY

It must be borne in mind that world conditions to-day exert some influence on the particular use to which any given piece of land may be put. This influence is exerted either directly or indirectly through such agencies as protective tariffs, export quotas, and subsidized production. In addition to these external factors there are many others, both local and national in character. The whole question of land use to-day is tied up inseparably with the economic and social aspects of community life. These two factors are basic and cannot be divorced. That being the case, the question of marginality of land is very important. A definition of marginality in the economic sense is very difficult because of the wide diversity of factors which cause land to be either sub-marginal or super-marginal for certain purposes. In the social sense the definition is more simple, sub-marginal land being land on which no farmer, however skillful, can support a decent standard of living. Land may be super-marginal when wheat is selling at $1.00 per bushel and be sub-

marginal when wheat is selling at 50 cents or even 75 cents; thus price is a major determining factor in the utilization of land. A piece of land located 25 miles from a railway may be of equal productive power with that located 5 miles away from the shipping point, yet it may be sub-marginal because of the added cost and difficulty of getting the product to market. Thus the relationship of transport facilities is very important. Similarly, two parcels of land of equal crop producing power situated at some distance from each other are affected differently by climatic factors. One farm may be located in a district in which 3 years out of 5 the distribution of rainfall in the growing season is such as to produce a poor crop, while the other farm receives the extra precipitation which spells the difference between profit and loss on the long-time programme.

The size of farm unit is another very important and variable factor. In the semi-arid areas where wheat is practically the whole marketable product and where annual yields are low, it will be necessary to have larger units of production. There is a limit to the size of farm unit, however, which is reached when the burden of taxes necessary to maintain the required social services, such as lines of communication, schools, churches, doctors, hospitals, etc., is spread out between too few people. Again, in districts where the farm unit is too small, tax delinquency is an inevitable result. This throws a still heavier burden on those who are able to pay, and the general situation affects the credit of all within the area. Agricultural technique and methods of farming are factors that may and are determining the use of land. The advent of large-scale farm machinery with the consequent mechanization of farming in the prairie plains has been one of the biggest factors in land use in the West and it is one phase of dry farming that has not received sufficient attention. There is good ground for believing that complete mechanization of farms in the drier sections along with a different social organization may make it possible for those areas to maintain a farm population much greater than is the case at present, but this phase of the situation will be discussed more fully later.

Another very important factor in land use to-day is the rapid motorization of farm machinery and the effect of this on market demand must never be lost sight of in planning a long-time programme. Baker (5) states that the introduction and increasing use of the automobile and farm tractor in the United States since the war has permitted a reduction of over 8,000,000 horses and mules, thereby releasing 25,000,000 acres of crops which required to produce feed for them and are now used to grow and feed beef and to grow cotton. In other words, this change in farm motive power has increased the acreage available for the production of other crops by about 12 per cent in 12 years.

CHANGE IN DIETS AND THEIR EFFECT ON LAND USE

In all countries of the world to-day changes in the national diet are taking place and will continue to do so. In some countries the change is to use more cereals and less meat, and in others the opposite is true. As far as the individual is concerned, these changes are of slight importance, but when viewed from the national aspect they are very important in causing changes in the use of land. For example, it requires over 2 acres of crop to feed the average American, but only one acre to feed the average German, half an acre to feed a Chinaman, and one-quarter of an acre to feed a Japanese. The difference between the latter two is accounted for by the greater yields obtained in Japan, the basic diets being the same. From this comparison of the acreage requirements for food production it can readily be seen that the effect of any major change in food habits will be tremendous and this fact should never be lost sight of by any section of country which is limited by climatic and geographic conditions to the production of a very limited variety of crops. Having discussed at some length a number of the main factors which determines the use to which land will be put, we may now turn our attention to the actual situation in Western Canada as far as the settlement of the so-called Drought Areas is concerned.

THE HISTORICAL SETTING

In discussing the problem of land settlement it is well to have in mind what are the fundamental requirements of successful settlement and what are the motives of the settlers. In the introduction to his book, "Prairie Settlement," McIntosh (17) states that, "The settlement of a pioneer area is carried out by many individuals driven by many and diverse motives; of these the economic is by no means dominant. Successful settlement, however, can only be achieved if an adequate income is possible—adequate in providing a reasonable standard of living, and

adequate in comparison with alternative incomes. To insure adequate incomes, access to expanding markets is essential, and land suited to the production of marketable commodities. Land can be deemed suitable only if there have been developed arts of utilizing the particular types of land available. The land must be sufficient in quantity to support a volume of production and a density of population capable of maintaining the economic, social and governmental services which are deemed essential. Where these conditions are not fulfilled settlement fails and is succeeded by poverty, abandonment and deterioration." It is well to keep these conditions in mind because they are fundamental to the success of any farm population in any area.

In 1901 the population of the three prairie provinces was approximately 420,000, with 5½ million acres under cultivation. From 1901 to 1911 there was a rapid influx of settlers, with 1911 being the peak year. Previous to 1906 there had been no invasion of what is known as "Palliser's Triangle" by the grain farmer, but from this time on there was a continuous increase in settlement within the Triangle, particularly after 1911, and at this point it may be well to review briefly the story of Palliser's Triangle (24) and some of the geology and climatology of the short grass plains, because much of the tragedy of prairie settlement is associated with this area and the problem of its use is one of the most important to be faced by governments, both Federal and Provincial. During the years 1857 to 1860, Capt. John Palliser, accompanied by Dr. Hector and others, was commissioned by the British Government to explore "that portion of British North America which lies between the northern branch of the River Saskatchewan and the frontier of the United States, and between the Red River and the Rocky Mountains, and to record the physical features, nature of its soil, its capability for agriculture, the quantity and quality of its timber, and any indications of coal or other minerals." As a result of his explorations Palliser divided the country between the "Laurentian Shield" and the Rocky Mountains into two parts, the "fertile belt" and the "semi-arid desert." The fertile belt was the wooded and park area, while the more or less arid desert was the treeless prairie or "true prairie" as he called it. Following his survey of this area, Palliser sketched his now famous triangle, which is more nearly in the shape of an irregular pentagon. This triangle at its base on the United States boundary extended from Turtle Mountain in Manitoba to a point near Waterton in Alberta on the west and then north-west to the old Bow Fort on the Banff highway. From there the line ran north-east to Olds and then almost due east along the 52nd parallel to a point south of Saskatoon, and from there south-east to its junction with the base line on the 49th parallel at Turtle Mountain. From the map it will be seen that this triangle took in more territory on the west than was justified, but in the main it corresponds to the dry area as we know it to-day. In his daily journal as he explored the region, he often mentioned that sloughs and creeks were dry and that he had difficulty in getting water for his horses and that pasture was very scarce in many parts. Palliser gave it as his opinion that the northern fertile belt was well suited to agriculture and would maintain a farm population, but that the area within the triangle was unsuited to agricultural settlement. Speaking more particularly of that portion of Palliser's Triangle which lies in south Saskatchewan, Hind (11) in 1860 said, "No tree or shrub or even willow could be seen in any direction from our camp (near Moose Jaw Forks) . . . the country was an undulating, treeless plain, with a light and sometimes drifting soil, occasionally blown into dunes, and not in its present condition fitted for the habitation of civilized man." Prof. John Macoun (19) said in 1879, "There were at least 400 miles from Moose Jaw where there were no trees and scarcely a shrub. . . . In 1879 I found dried and withered grass . . . in 1880 there were dried creeks on each line of travel . . . and again in 1894 the country was drying up, lakes were disappearing, many settlers were leaving the land. Nearly all the lakes and streams on the prairie had dried up and ceased to flow. . . . In all my explorations so far we have found the country extremely dry." This statement is all the more interesting because Macoun had previously taken exception to some of the estimates concerning the dry area made by Palliser. Later on, in 1904, when reporting to the British Board of Trade, Prof. Jas. Mavor (21) stated that the area approximating Palliser's Triangle was mainly suitable for pasturage and to a very limited extent for wheat.

The foregoing are the most important of the early statements made concerning the use to which a large area of Western Canada should be put. The accuracy of those statements is a matter of record to-day as well as the results of not paying closer heed to the advice they contained. These early records very effectively answer a mis-statement that is frequently made to-day, namely, that the climate of Western Canada has changed and is becoming more dry as the years go by. This is definitely not so. The Western plains have always been subject to re-

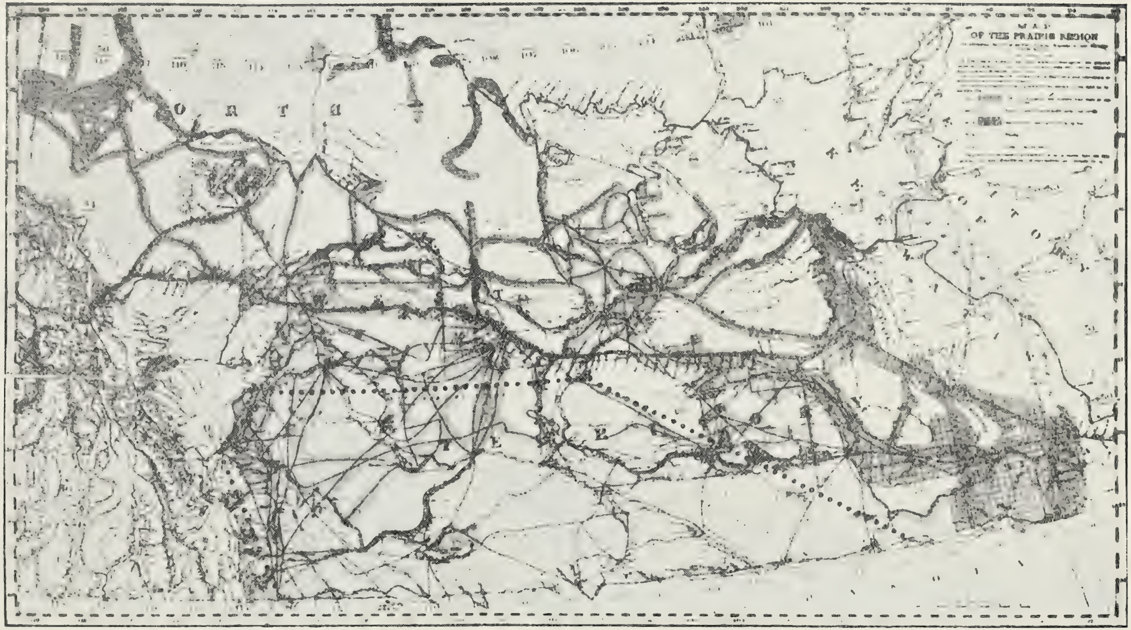


FIG. 1—Reproduction of the "Map of the Prairie Region . . . to distinguish the physical character of the country or the routes followed by different Explorers and Scientific Travellers" which accompanies the report for 1880 of the Engineer-in-Chief of the Canadian Pacific Railway. The dark grey areas represent the belts of land along explored routs which were considered suitable for agriculture. The dark dotted line, which is not on the original map, has here been added to show "Palliser's Triangle"—the area south of which line Palliser in 1860 considered infertile land.

curring cycles of deficient rainfall with the attendant difficulties of feed shortage and soil drifting, and will in all probability continue to be so. This being the case, the plans if Western agriculture must be made with the long-time view, which means taking every precaution during good years which will help to minimize the effect of drought and soil drifting in the dry years. It means putting fibre in the soil, planting trees where this can be done, conserving water supplies and, above all, the creation of an operating reserve if at all possible in order to carry the farm enterprise over a period when the returns are small.

THE CANADIAN DESERT

Until recent years very few Canadians have associated the word desert with the dry section of the prairie plains because we have been taught to believe that a real desert is a barren waste of rock and shifting sand. This is true in the exact sense of the word, but there are different kinds of deserts, and great portions of the desert regions of the world which are to-day inhabited by nomadic peoples, such as parts of the Sahara, the northern edge of the great Gobi, and the Rub al Kail or Empty Quarter of Arabia, differ very little from our own dry area, except in the respect that the nomads who live there, through generations of experience, have learned to leave them unplowed. In their natural state they are providing pasture and in some cases grain. Major Stuart (29) in his booklet, "The Canadian Desert," makes comparisons between what he calls the "steppe desert" of Western Canada and similar steppe deserts in other parts of the world, and he comes to the conclusion that if the population of Western Canada will persist in using this area they will perforce have to adopt the same methods as the peasants of Kurdistan and Armenia have had to do in theirs, namely, make a change from constant cropping and wheat growing. While Major Stuart's statements and conclusions are rather sweeping, there is sufficient truth in them that they cannot be ignored. The annual precipitation of the northern edge or steppe desert portion of the Gobi Desert is 9.7 inches, which is slightly under the annual rainfall of our Canadian desert region, as will be seen from the map showing the average precipitation during the growing season over a period of 35 years.

The average rainfall during the period April-September in the dry area varies from 7 to 9 inches, and in certain years the precipitation is much lower during this important period, except in certain areas, such as the Cypress Hills. Over the whole occupied area of Western Canada the map indicates that the average rainfall during the growing season does not exceed 13 inches. This indicates that at no time in the Canadian West are we far removed from the gaunt spectre of drought. But in the short grass plains, the history has been that in practically 7 years out of every 10 drought has caused untold want and misery over certain sections of the countryside.

With the coming of the railways, settlement poured into the short grass plains. From 1911 onward, the rancher who had previously occupied this area was progressively crowded out, and by 1920 settlement was almost complete. Bumper crops and high prices in 1915 and 1916 had removed the last remaining misgivings on the part of those who were afraid of the short grass plains. Roads, telephones, schools, churches, and social services of all kinds were demanded and provided—the whole superstructure literally built on stalks of golden wheat, in a foundation of shifting sand. Then came 1917, 1918, 1921 and 1922—drought, discouragement, and despair—the covered wagon and the settler on the move again like wild geese in the Spring going north. Another lease of life, good crops in 1926, 1927 and 1928—then drought again, followed by wholesale abandonment—40%, 50%, 60%, and 80% in some districts. The burden of taxation necessary to maintain necessary services bearing heavier and heavier on the settlers who remained. Finally it became difficult to operate schools, to maintain roads. Telephone lines were abandoned by the hundreds of miles. Life became more primitive and intolerable through lack of a natural community life. Such is the history of the greater portion of Palliser's Triangle—one of the greatest mistakes of national policy ever made.

The foregoing section has dealt with some of the outstanding facts of the general situation as it is likely to affect a particular area, and also some of the history of the short grass plains. This period may well be described as the period of expansion, and the succeeding section will deal with the re-organization, and might well be called the period of consolidation.

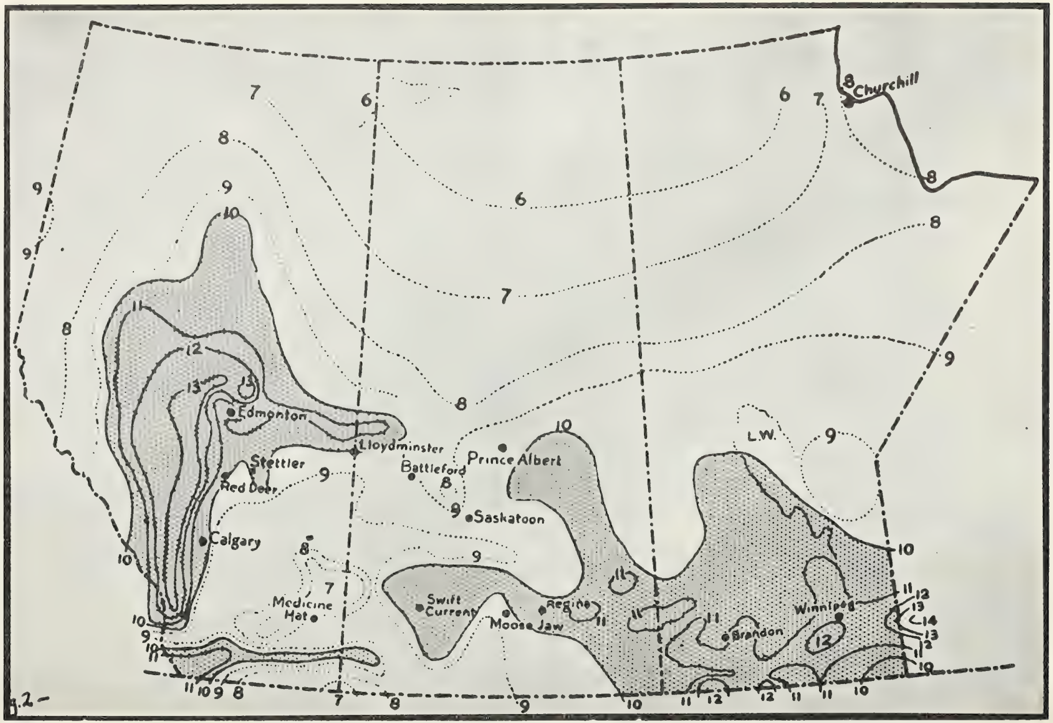


FIG. 2—This map, to which reference is made in the text of this pamphlet, shows thirty-five years average precipitation during the growing season, April-September. It is compiled by the Dominion Bureau of Statistics. The period covered is from 1896 to 1931. In the dark shaded areas the average precipitation has been 10 inches or more, sufficient to ensure crops. In the white areas the average fall is disclosed for the several districts by the dotted lines and figures.

THE PERIOD OF REORGANIZATION AND CONSOLIDATION

Area and Geographic Setting—Physical Features and Drainage

As was pointed out in the previous section, the dry area of Alberta falls well within the boundaries of what is known historically as Palliser's Triangle, but more particularly the belt of light brown soil extending from the Saskatchewan border westward along the United States boundary to a point south of Stirling. Northward on a line drawn midway between Lomond and Vulcan, passing several miles west of Bassano, then in a north-easterly direction, passing through Hanna and Coronation and flattening out in an easterly direction until it crosses the Saskatchewan boundary near Provost. This territory, with the exception of an area which includes the Cypress Hills, is of a light brown soil colour, and contains the portion of the Province most seriously affected by drought. In certain seasons, such as that of 1934, when drought is more widespread than usual, the dry area extends west and north to include the dark brown soil belt. Starting from a point on the Saskatchewan border, east of Paradise Valley, the line runs north-west through Hardisty, Gadsby, Huxley to Cochrane, and thence south on a line about twenty miles west of Calgary, High River and Macleod, and swings south-east to cut the United States boundary at Carway. Within the two areas described, practically all of Alberta's drought problem is found, but it is only on rare occasions that drought is a serious matter in the western and northern portion which is made up of the dark brown soil belt.

Included within this total area are the various irrigation projects of Alberta, comprising some 351,282 acres under the ditch at the present time, and 1,020,229 acres surveyed. While the irrigation districts have their own special problems, they are not properly a part of this report, and will not be discussed here.

The outstanding physical features of the Brown Soil Area are the Cypress Hills in the south-east corner, rising to an altitude of 4,500 feet; the Milk River Ridge, rising to 4,000 feet at the south-west corner of the light brown soil area; the Hand Hills, with an altitude of 3,500 feet on the west central side of the light brown soil area; and the Wintering Hills, situated in the dark brown soil belt, south-west of Drumheller; and on the north an elevation of lesser importance, the Nose Hills, north-east of Coronation. Between these elevations the land is gently rolling and undulating, with an altitude varying between 2,800 and 2,000 feet, gradually sloping north-north-east. The main part of the area is the drainage basis of the South Saskatchewan River, which includes the Old Man River, coming from the West; the Bow River and its tributary streams from the west central section, running south-east; and the Red Deer River, coming from the north-west corner and flowing in a south-east and easterly direction. The Battle River cuts in on the northern boundary of the dark brown soil belt, and drains that portion into the North Saskatchewan. Between the Battle River and the Red Deer River is a vast expanse of territory very poorly supplied with lakes and streams, and in much of the area the surface water supply is very scarce. South of the Red Deer River the situation is even worse. Over the whole area there are only a few fair sized lakes or irrigation reservoirs—these are: Pakowki Lake, Sullivan Lake, Lake Newell, Lake MacGregor, and Namaka Lake, the latter three being irrigation reservoirs. Taking the area as a whole, and particularly the area of light brown soil, it must be admitted that there is a great scarcity of surface water, such as is supplied by lakes and streams.

As far as the supply of well water is concerned, Allan (1), in speaking of the artesian water reserve, points out that the three essential factors are a porous rock, such as sandstone, which will act as a container in absorbing the water; an impervious rock, such as shale, to prevent the water escaping to the surface as seepage; and an impervious floor, also shale, which will prevent the water from becoming dissipated in the lower formations. These three factors are all present in southern Alberta, and especially in the south-eastern part of the Macleod sheet, and the south-western part of the Medicine Hat sheet. The depth of the water-bearing strata over this area has been proven to vary from 680 to 1,500 feet, depending on whether the well was drilled in the eastern or western section (the water-bearing formation is nearer the surface as Medicine Hat is approached). Generally speaking, the depth at which these water-bearing sandstones occur makes the cost of drilling for artesian water excessive.

Smaller sources of water supply, sufficient for individual use, can be obtained by drilling and pumping from depths of 150 to 600 feet over the greater part of the area, which includes the Macleod and Medicine Hat sheets, and the area lying between them. Further north, in the Sounding Creek, Red Deer and Rosebud sheets,

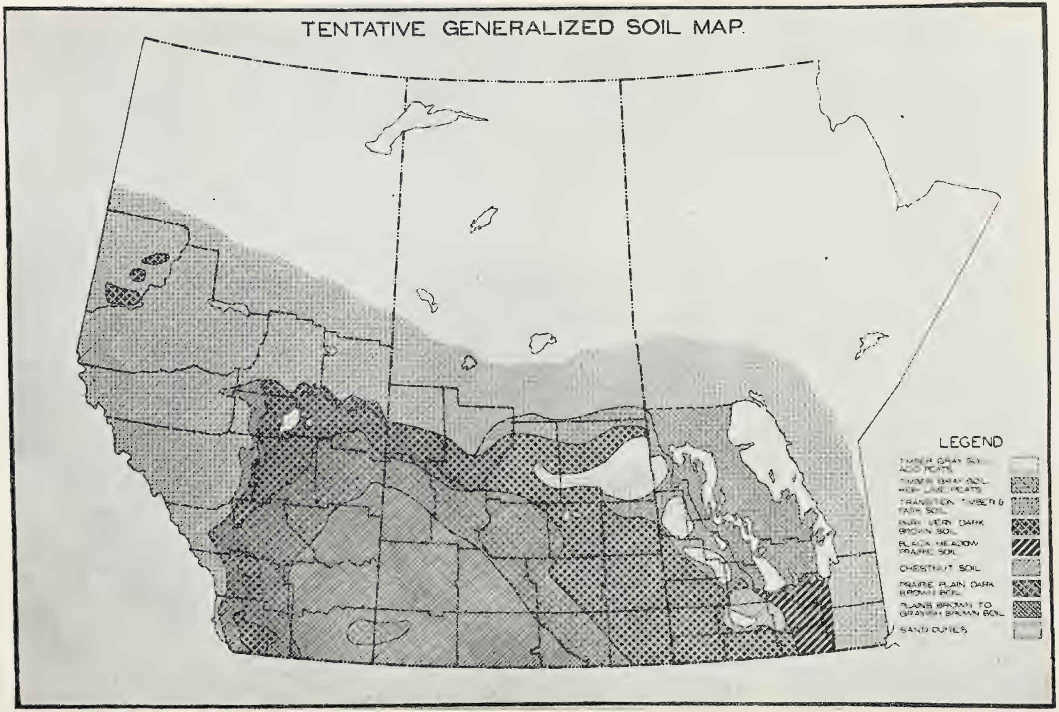


FIG. 3—Tentative generalized soil map showing the approximate boundaries of the different classes of soil in the prairie provinces.

there are sources of spring water in the vicinity of the Hand Hills and Wintering Hills, and shallow water reserves in the Edmonton formation, which consists of clayey sandstones and shales usually high in gumbo. Farm wells over this northern area vary in depth from 100 to over 500 feet. The water is usually hard and sweet.

THE SOIL

The Parent Material

In as much as the parent material has a direct influence on the nature and texture of the soil in any area, it might be well to briefly describe the parent material from which the soils of Alberta's dry area were formed.

Generally speaking, soils may be regarded as unconsolidated rock, which have been derived from the disintegration and decomposition of older rocks, through the various agencies of weathering, erosion, abrasion and the action of chemical compounds in nature. Most of the surface of the dry area of Alberta is covered with deposits of unconsolidated rock of glacial origin. The covering varies in depth, according to location from a few inches to over 200 feet. The soils are of Pleistocene and recent ages, the former consisting chiefly of glacial material, while the younger or recent deposits are derived from older glacial deposits.

Starting on the western side of the so-called dry area, we find that the underlying rock belongs to the Belly River formation, a mixture of clayey sandstone, sandy shales and soft clay, belonging to the upper Cretacious time. The cementing material in the sandstone is soft clay, which means that the rocks are easily eroded. Belly River rocks underly practically the whole of the dry area from Macleod east to the Saskatchewan boundary. Much of the "fine sand" soil type at the mouth of the Little Bow River, along the Old Man River, north of Taber, and along the Bow River, has been derived from the weathering of underlying Belly River rocks. Again in the Sounding Creek sheet, the sand dunes around Antelope Lake are mostly derived from Belly River and Edmonton sandstones. Smaller sand dune areas occur in the sandy loam west of Naco and north-west of Hemaruka, and again in the glacial morainal territory east of Esther and south of Alsask, these are of the same origin.

The Bear Paw formation, consisting of dark clay shales with occasional beds of sandy shale, overlie the Belly River formation. The western edge of this series is represented by a line drawn from Lomond to Monarch and passing through Sundial Butte and Black Spring Ridge.

The Bear Paw formation is high in sodium, magnesium and aluminum sulphates, and these minerals are probably partly responsible for the alkali content of certain soils in the area. The Bear Paw shales underly the area east of Range 5, and are well developed from Walsh to Irvine. Further north there is a large area of loam soil, chiefly north of the Goose Lake line in Ranges 3, 4, 5, 6 and 7, which is believed to be largely of residual origin from the Bear Paw shales. In the west half of the Sounding Creek sheet, the loam "blow-out" type soil is underlain by Bear Paw shale and sandy shales of the lower Edmonton formation.

In the south-western corner of the Province the Bear Paw shales are overlain with the St. Mary's River formation, consisting of soft cross-bedded sandstones, and sandy shale, with coal near the base. This formation corresponds in glacial age and rock constituents with the Edmonton formation further north.

The western edge of the St. Mary's River formation is represented by a line drawn from the Little Bow southwards to Claresholm and then to Macleod. The lime content of these rocks is very high and it forms the cement in the sandstone. Bentonite, which in the impure form is gumbo, is an important constituent of these rocks, and the very heavy clay and gumbo soils are formed from material weathered from them. Some of the heavy clay loam south and west of Lomond, around Champion, and along Rocky Coulee south-west of Barons, is weathered from these rocks. On the other hand, much of the fine sand along the Little Bow from Clear Lake, east through the Carmangay district to the Little Bow reservoir, has originated from the disintegration of sandstones in the formation. Similarly, much of the "silt loam" area so widely distributed through the centre of the Macleod sheet from the Old Man River through Nobleford and west of Lake MacGregor to Reid Hill east of Vulcan, has been derived from the weathering of the soft sandstone. The action of wind and water have been responsible for a considerable amount of resorting in this area. Along the Red Deer River the Edmonton formation corresponds

to the St. Mary's River formation in the Macleod sheet. It is made up of essentially the same material. The coal deposits at Drumheller, Sheerness, and Richdale are all found in the Edmonton formation which overlies the Bear Paw shales. These rocks are high in lime and impure Bentonite, thus the very heavy clay and gumbo soils from Three Hills east and south through Morrin and Drumheller, and extending eastward to between Craigmyle and Hanna, are derived mainly from this formation. These soils are not characteristic of the Sounding Creek area, although it is possible that the small patches of clay and clay loam and mixed type of soil shown around Bullpound Creek have been formed from Bentonitic rocks in the Edmonton formation. The sandy loam area in the Sheerness Ridge east of Bullpound Creek and extending north-west toward Hanna, has also been formed from the more sandy strata of the Edmonton formation.

The youngest and therefore the uppermost rocks in the western part of the brown soil belt belong to Teritiary time, and are classed as the Willow Creek and Porcupine Hills formation. The corresponding formation of the same material further north around Calgary, and extending east to the Saskatchewan boundary, is known as Paskapoo sandstone, and, in passing, it might be mentioned that this is the material from which the main Parliament Buildings at Edmonton are made. The Willow Creek formation consists of clays, clay shales, soft sandstones, and some beds of thin bedded limestones. They generally have a reddish or purplish tint and their presence in any district can be detected by the reddish tint of the soil formed from them. In general, it may be said that Ranges 27, 28 and 29 as far north as Nanton are underlain by the Willow Creek formation, as the sandstones are soft, and contain a lime cement, they weather readily to sandy clay soils. The "fine sandy loam" extending from the mouth of Willow Creek, north of Mud Lake, to a point three miles north of Claresholm, have been derived from the weathering of the soft rocks on the outer eastern slope of the Porcupine Hills. The "light phase" of silt loam between Nanton and the Little Bow River and a similar area west of Parkland have been derived from these rocks. It is also probable that the loam area around Stavely has been derived from the clay members of this formation.

In the Red Deer and Rosebud sheets, and carrying out to the Hand Hills, the Edmonton formation is overlain by the Paskapoo formation consisting of soft clay sandstones, weathered yellowish, and shales that are sometimes classed as clays. Doubtless the weathered sand and clay of this formation in the Hand Hills area has been washed down and mixed with the other soil types on the western side of the Sounding Creek sheet.

Owing to the fact that detailed geological and soil surveys have not been made over the whole of the area covered by the brown soil belt, it is impossible to get a complete picture of all the parent material, but sufficient evidence is presented in the soil surveys of the Macleod, Medicine Hat, and Sounding Creek sheets, together with reconnaisance surveys in the intervening area, to get a picture that is reasonably accurate. It must be remembered always that the top soil differs from the underlying deposits upon which it is developed because weathering agents have changed its original texture, colour and composition. In most soils the accumulation of organic matter, both vegetable and animal, have caused the surface soils particularly to assume a darker colour. Again, surface leaching has deprived the surface soil of certain minerals, with the result that the mineral content of the sub-soil has been changed. With all the differences in parent material which find expression as the different types of soil in the area, there is a more or less uniform characteristic common to the whole area, namely, the colour of the top soil and the depth of the mineral or lime layer, and as the former is a result of the vegetative cover and the latter the result of the climatic conditions, it might be well to discuss them in that order.

The Cover

The brown soil belt of Alberta is part of the great treeless plain of North America, and as such supports a vegetative covering of grasses only. These grasses in the main are of the short or bunch grass type, which are usually to be found in areas where the annual rainfall is in the neighbourhood of 12 inches on the average. This amount of rainfall supports a short grass cover whose roots normally occupy the soil intensively for a depth of from 18 inches to 3 feet, and in some cases to a depth of 5 feet. The amount of top growth produced each year is small compared with the top growth in areas of higher rainfall. The result is that there is a comparatively small amount of organic matter to decay and become incorporated with the soil. There is sufficient, however, to darken the soil to some extent and

give it is characteristic brown colour. The depth of the organic matter varies with the locality, going from practically nothing in the dune or blow-out areas, to a few inches in the better areas. In order to bring out the effect of the covering on the colour of the surface soil, it is only necessary to make a comparison between the black soils and the brown. The black soils lie within a rainfall belt of 16 to 20 inches annually, and as a result produce a heavy grass cover with a consequently high percentage of organic matter to decay and become incorporated in the soil, the depth of black soil varying from 11 to 15 inches. Organic matter plays a very important part in determining the erosiveness of soils. Those soils which are high in organic matter contain from 15 to 30% more granules per unit of volume than those that are low in this constituent, and the granules are three times more stable when shaken in a water solution for 100 minutes. In a survey of soil samples made from Canada to Texas, Lutz (16) found that as the percentage of organic matter increased the porosity of the soil and the stability of the granules in the soil was increased. He found that there was an inverse relationship between the organic matter content and the erosion and dispersion ratios of soils. The more organic matter the less tendency to erosion. In other words, organic matter such as supplied by plant roots acts as a cementing material, and consequently leads to a decrease in the erosiveness of soils. This fact should be borne in mind in considering the tendency of any soil to drift as a result of wind erosion. The amount of rainfall received in the brown soil belt is sufficient to produce the grass cover which has been described. Where the amount of organic matter or plant material produced is scanty, it follows that the nitrogen content of the soil will also be scanty. Except in the dune areas and "blow-out" areas, however, the nitrogen content is sufficient for the purposes of crop production. On the other hand, although the rainfall over the brown soil belt is not sufficient to produce a heavy grass covering, it likewise is not sufficient to cause the same amount of leaching of other necessary mineral elements as is the case in the black soil belt further north. This means that the mineral or lime layer throughout the brown soil area is to be found at depths varying from 9 to 14 inches from the surface, thus it is well within the growing depth of plant roots. This in part explains why, when moisture supplies are adequate, the brown soil produces such bountiful yields—the supply of necessary plant food is there in abundance, providing sufficient moisture is received to put it in solution in which form it is available for plant food.

CLIMATE

In planning any long time programme for the rehabilitation of the dry area of Alberta, it is particularly necessary to keep in mind the effect of the climate on that programme. If it is a truism that a country is largely a product of its climate, we can face the fact that the type of climate which produced the semi-arid areas is one which is not likely to change very materially for a long time to come. From this point of view, then, the situation is a stable one, and plans can be made accordingly. The phase of climate with which we are most concerned is that which has to do with precipitation and evaporation. Given sufficient precipitation, there would be no drought area, and in years when the moisture supply is sufficient there is no drought problem. This being so, it may be well to have clearly in mind the causes of drought, or better still, the causes of precipitation. As everyone knows, precipitation which comes in the form of either rain or snow results when a current of cold air pushes in under a current of warm, moisture-laden air, pushing it up to a higher altitude, and thus bringing about a change in temperature by cooling. An illustration used by Ayre (4) in McLean's Magazine makes this action clear. A ten-foot cube of saturated warm air with a temperature of 80 degrees F. travels forward with a load of 25 oz. of water. It is met by a wedge of cold air which, being heavier, forces the warm air upward so high that its temperature drops 30 degrees. It loses two-thirds of its moisture and has left only 9.3 oz. The higher it is shoved by the cold air the more moisture it loses and of course the heavier the rainfall. This warm air must be moist as well as warm in order to get rain. Hurd and Grindley (14) state that "the occurrence of rain in appreciable amounts in the prairie provinces is dependent upon the advance southward of relatively cool air masses from the north-east and north-west. The advance must occur in such a way that while warm air masses carrying water vapour from the south are invading the grain belt, they are surrounded in their further advance by an environment of relatively cool, dry air of septentrional (northern) origin. In this environment the vapour-bearing air masses ascend, expand and cool to such a temperature that they are no longer able to retain their moisture. The excess is then precipitated as cloud, fog or rain. A nice balance between the moments of the southern and northern air masses must exist if rain of a moderate or heavy quantity is to fall. Too rapid an advance of cool air from the north-east

across Manitoba cuts off the supply of moisture-bearing air from the south, so that rain fails to occur in Western Manitoba or Saskatchewan, although heavy rain may occur in Western United States on the margin of this cool north-east polar front. Failure of the cool air masses to advance from the north-west allows warm air to sweep north over the grain belt. During these hot spells, the amount of moisture carried in the air is often enormous, but since there is no interference with the northward movement, no precipitation occurs, and very often very little cloud forms. The combination of strong sunshine and great heat in these rainless spells rapidly depletes the soil moisture. In southern Alberta and south-western Saskatchewan in Summer, air masses of south-westerly origin (chinooks), which have a very low water content but are very warm, often issue from the plateau region farther south. If such a circulation is not quickly displaced by the southward advance of a cool wave, scorching of the standing grain occurs. In the foothills of Alberta, and also in the Peace River country and the adjacent region from Lesser Slave Lake to Edmonton, good rains may occur, while the central region suffers from drought. This appears to be due principally to two reasons. First, warm, moisture-bearing air which has passed over the central regions may meet a cool environment in the northern latitudes or in the higher elevations of the foothills, although this cool environment lacks sufficient energy to carry further south. Second, in the hilly regions of eastern Saskatchewan and the so-called park belt, scattered thunder storms will occur due to local extensions of tongues of cool air through the hills, when the conditions for rain are not sufficiently advanced for general rain over the prairies."

The phenomena of the mixing of the air currents and the consequent rising of the warm, moisture-laden air may explain the reason for the extra precipitation in and adjacent to areas of high altitude. The outstanding example in Alberta of this is the Cypress Hills, which receive from three to four inches more rainfall annually than the surrounding plain, with the resulting very great difference in vegetation. Similarly, smaller elevations such as the Hand Hills, Wintering Hills, Neutral Hills, and others of lesser importance, are responsible for a greater amount of rainfall in that area than in the adjacent plain. It is claimed that at irregular intervals currents of polar air break across the continent in a series of waves and in normal seasons they come in contact with the warm, moisture-laden air from the Gulf of Mexico. When this happens in normal sequence, all is well on the Canadian prairies, but for some unexplained reason during the last few years, the Gulf air has changed its position and, instead of coming warm and moisture-laden from the Gulf of Mexico, it is coming from somewhere in the interior of Mexico. Instead of being warm and moisture-laden, it starts warm and dry, with the result that when it meets our polar air, there is very little moisture to precipitate, and four years of drought have been the lot of the Canadian prairies. According to the meteorologists, from 1930 to the Fall of 1934, we were getting dry continental tropic air instead of moist Gulf air. They do not know why this is so, but it is a fact. It has occurred before, and the Western farmer should be prepared to expect it again.

DISTRIBUTION OF RAINFALL

In the semi-arid areas, it is not so much the total amount of rainfall as its distribution that counts. Generally speaking, most of the total precipitation occurs as rain—about 5% falling in April, 12% in May, 15 to 20% in June, and some in July, and 10 to 15% in August—or about 60 to 70% of the annual total from April 1st to August 31st. Although there is great local variation in the amounts of rainfall received each month, long-time records indicate that there is a tendency for the maximum raininess of the year to be reached in the period May 15th to June 15th in south-western Alberta, and from June 1st to 15th in southern Alberta and south-western Saskatchewan, and from June 15th to July 1st in the central portion of the grain belt. Frequent moderate rains or showers in June, with only short spells of intense heat, produce much greater crop results than heavy rains with long spells of hot weather in between. The very great variability in the extent and quantity of summer rainfall, and the frequent occurrence of great heat during the dry spells, constitute the major problem of the semi-arid region. Depletion of soil moisture and injury to crops and pastures vary directly with excessive heat and inversely with the rainfall. In order to show this graphically, Hurd and Grindley (14) used the following scheme to produce the accompanying graph, which gives a clear picture of the relationship between high temperatures and rainfall in the prairie regions. The average mean daily highest temperature in June and July over a period of years at all recording points was divided by the average rainfall for the same period. The resulting quotients were entered upon a map

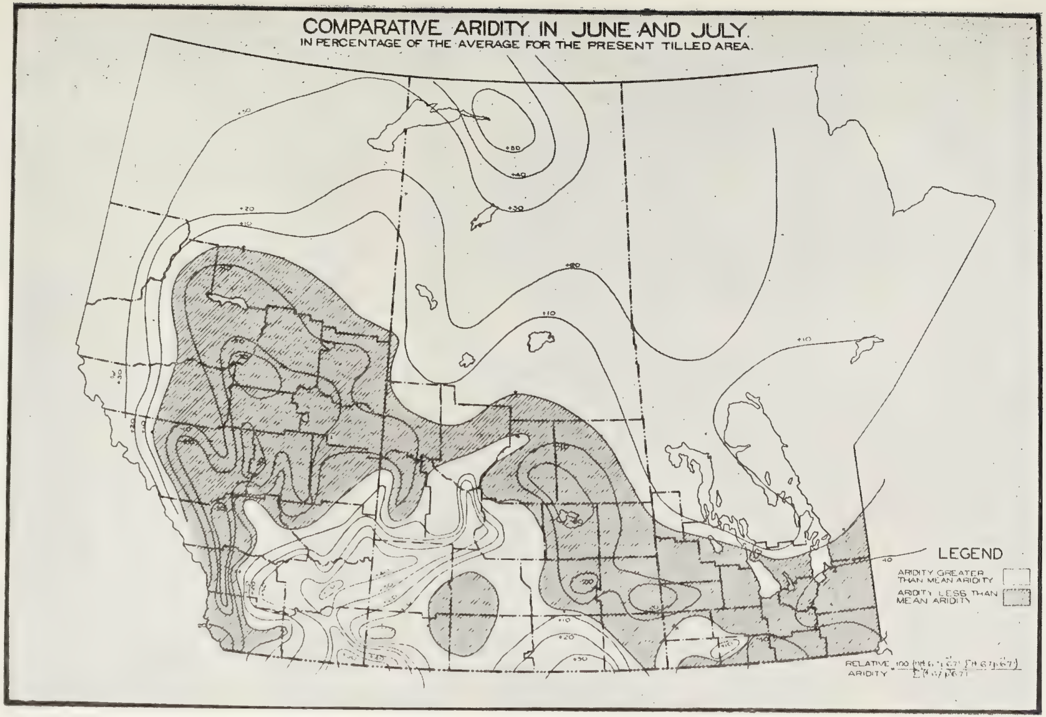


FIG. 4—*Courtesy of Dominion Bureau of Statistics.*
Showing tendency to aridity as arrived at by corelation of rainfall and temperature.

at their proper points. The average value of the quotient for the present grain belt was then determined by integration. The percentage proportion which every point-quotient bore to the general average was then determined and entered again upon a map as shown. The regions where the tendency to aridity is greater than the normal are distinguished from where summer conditions average better, by shading.

The map is differentiated by lines indicating equal increments or decrements of 10 per cent. of the mean value in the area generally cultivated at the present time. The lines have, therefore, no absolute meaning, but indicate only relativity. The line passing through points exceeding the average point quotient by 40% is, however, easily recognized as the approximate boundary of the region widely known as the dry belt. This area begins in south-western Saskatchewan and south-eastern Alberta in that part of the Milk River basin lying south and west of the Cypress Hills. Including a portion of the Etzikom and Chin Coulees region as well as Lake Pakowki, it extends north of the Bow River. Here the dry belt covers most of a triangular area lying between the Bow, the South Saskatchewan and the lower Red Deer Rivers, and extends into Saskatchewan again beyond the confluence of the Red and South Saskatchewan Rivers. The lines of 40 and 50% increment of average aridity are thus tied to a generally known feature of the West. With the plus 40 per cent. line a datum level, we can judge that the plus 30 line includes a further region where the tendency to droughty conditions is nearly as great. This line takes us west nearly to Lethbridge, to Bassano on the north-west, to the Sounding Creek region on the north, and along a narrow tongue north-east almost to Saskatoon. From Outlook the boundary runs south-west through Saskatchewan back to Medicine Hat in Alberta. By looking at the accompanying map supplied by the Dominion Bureau of Statistics, showing the 35-year average rainfall during the growing season April to September, it will be seen that there are definite rainfall zones. The zone of lowest rainfall being that area immediately north of Medicine Hat and extending to the Red Deer River and west to Bassano and south to Retlaw, or approximately the whole of census division No. 3. The total 35-year average precipitation in the growing season being only 7 inches, as compared with 10 at Red Deer and 11 at Edmonton. The seven-inch zone is surrounded by a narrow border of 8-inch rainfall. Then over practically all of the brown soil belt, including the north half of census division 1, the north-east third of division 2, all of divisions 3 and 5, and the east half of 6, the south-east corners of 8 and a narrow strip on the south of division 7, we have an annual average precipitation of 9 inches in the growing season. It will be noticed on this map that a zone of 10-inch rainfall stretches from the foothills on the west right across the Province and into Saskatchewan in the form of a long, narrow tongue running east and south from Lethbridge to the Cypress Hills. South of this again the rainfall decreases progressively until we get another 7-inch area in the very south-east corner of the Province.

While average figures are interesting in presenting the long-time picture, they are apt to be mistaken from the standpoint of crop production. The farmer is not interested as much in the average rainfall as he is in the number of years within a given period that the rainfall of a given area fell below the amount required to produce a crop, and while the number of points for which rainfall records are available is all too few, some conclusions can be drawn from the figures we have. The only point actually in the dry area for which long-time figures are available is Medicine Hat, where the record goes back 49 years from 1934. If we consider 12 inches as the minimum annual precipitation reuired in the dry area to produce a crop, we find that the annual rainfall was deficient in 29 years out of 49. In four years—1886, 1889, 1907 and 1910—the rainfall was less than 7 inches, the lowest record of all being 5.47 inches in 1886. In 7 years out of 49, the rainfall was below 8 inches; in 12 years out of 49, it was below 9 inches, and in 22 years out of 49, the rainfall was 10 inches or less. The record does not show any regular cycle of wet and dry years, although it does seem that wet and dry years follow each other in groups more often than they come singly. From 1885 to 1895 there was a period of 11 dry years, the highest rainfall being 11.98 inches in 1888. This was followed by 7 years of ample rainfall from 1896 to 1902, during which time the minimum rainfall was 13.68 inches, and the maximum 22.28 inches. 1903 marked the beginning of another 8-year period of dry years—1903 to 1910—in only one year of which the precipitation exceeded 9.9 inches. From 1911 to 1917 was another 7-year period of wet years with the exception of 1912, when only 9.7 inches of rain fell. From 1918 to 1924 rainfall was less than 12 inches except in two years, 1921 and 1923, when slightly more than this fell. The years 1925 and 1926 were years of satisfactory moisture and this followed again by four dry years from 1928 to 1931 inclusive, after which rainfall was adequate for three more years. At two other

points, Calgary and Lethbridge, where records are available from 1886 and 1902 respectively, we do not find exactly the same situation. At Calgary there were 10 dry years from 1886 to 1895, thus coinciding with the Medicine Hat records. In only 4 years, 1910, 1917, 1918 and 1919, was the rainfall at Calgary 12 inches or less. At Lethbridge the annual rainfall fell below 12 inches in 1909-10, and again in 1917-18. At Bassano in the period 1923-33, 6 years out of 11 had rainfall in excess of 12 inches. The period was divided into two, 1923-28 being wet years except 1926, and 1929-33 dry ones. At Brooks 5 years out of 10 experienced less than 12 inches of rain in the period 1924-34. At Patricia, 9 years out of 12 had less than 12 inches; at Gem Colony, 7 years out of 12 had less than 12 inches, and the same was true of Jenner. At Gleichen 5 out of 12 years had less than 12 inches, and at Three Hills 5 years out of 12 had less than 12 inches. These points which are situated either in or on the fringe of the dry area serve to show that farmers must be prepared to expect deficient rainfall in from 5 to 6 years out of every 10-year period, and that the duration of the dry years is more often than not three to five years.

EVAPORATION

Another factor which must be borne in mind in considering the effectiveness of rainfall in the dry areas is the amount of evaporation. Due to the frequent high winds and greater number of hours of sunshine experienced in the treeless plains area of Alberta, the amount of evaporation from a free water surface is much higher than from a similar surface in the park belt. Wyatt (32), in his soil survey bulletin of the Medicine Hat sheet, states that for the months of May, June, July, August and September, 1919, the evaporation from a free water surface at Claresholm was 28.11 inches as against 19.25 inches for the same period at Olds, the evaporation at both places being greatest in July. These losses would indicate that losses of water by evaporation from a moist soil in the dry belt would be greater than from a similarly moist soil in the park belt. Another factor which mitigates against the effectiveness of the precipitation in the dry belt as compared with the park belt is the fact that the soil is exposed for long periods during the Fall and Winter months in the south, whereas in the north it is protected by a snow cover; frequent high winds, during the Winter, dry these soils out and cause a great deal of soil drifting. Very high summer temperatures, prevailing over comparatively much longer periods of time than in the park belt, also cause a greater degree of evaporation and a consequent lessening of rainfall efficiency.

FACTORS AFFECTING PRECIPITATION

As climatic factors affecting precipitation have been dealt with previously, this section will deal with physical factors such as topography, trees, lakes, and transpiration.

Sufficient was said in the discussion of the causes of rainfall about the effect of topography, that very little need be said here except to emphasize once more the effect of broken or rolling topography and elevations of land. It has been noted that wherever high elevations obtrude themselves above the surrounding plain, such as in the case of the Cypress Hills, the amount of precipitation received on these upland areas and adjacent territorry usually exceeds that of the surrounding plain. Usually the higher the elevation the greater the precipitation. The effect of elevations in forcing moisture-laden air currents up until they lose their moisture has been particularly noticeable during the last few years of drought. The Cypress Hills situated as they are, almost in the midst of the drought area, have shown very little effect of the drought which has wrought such havoc on the surrounding plains. This would indicate that even in these periods of dry years the air currents passing over the country have contained sufficient moisture to produce normal precipitation if they were forced high enough by natural obstacles.

A very common belief among farmers, is that rainfall follows the rivers and water courses, and while there is very little data available which tends to substantiate this belief, it is quite possible that the broken country provided by coulees and ravines, as well as the bends in the river, cause the warm, moisture-laden air currents to be forced up, with the result that rain occurs.

TREES

Much has been said and written during the last two years about the effect of trees on drought, some people even going so far as to claim that the whole problem could be solved by the planting of trees. The people who make such ex-

travagant claims are doing so without a knowledge of the basic facts of the situation, and are mixing cause and effect. Trees are a product of rainfall and not the cause of it. It is invariably true the world over that in areas where the annual precipitation is less than 12 inches tree growth is usually absent, and as the precipitation increases from 12 inches upward the tree growth and other vegetative growth increases up to a certain maximum. To recognize the truth of this it is only necessary to make a journey from the central plains of Canada, westward to the Pacific Coast. First, we have the short grass plains and brown soil; next, the long grasses and poplars and willows of the park belt of black soil. Then, further west, the change from a grass growth to a tree-covering, poplars, birch and pine increasing in size as the rainfall increases, until on the western side of the mountains the growth changes entirely and the giant fir trees, cedars, etc., of the Pacific Coast are encountered. The natural evidence all seems to indicate that when a certain minimum amount of rainfall is present and the evaporation rate is not too high, trees will grow naturally, but there is no evidence to show that trees planted in a wholesale manner in a semi-arid plains area will cause rainfall. It cannot be too strongly emphasized, however, that in those areas where trees grow naturally the native tree growth should be carefully conserved and a planned system of afforestation followed. There is no question that trees are a valuable asset in preserving or lessening the run-off and in holding the snow. This is particularly true on the eastern slope of the Rocky Mountains. There is some evidence for the belief that the rapid and extreme denudation of the mountain slopes is having some effect on the climate of Alberta, because of the fact that on the bare slopes the run-off is more rapid and there is a greater amount of it than formerly, with the result that moisture which might pass into the air by evaporation is carried away as run-off by the rivers. There is a further belief held by some physcists and meteorologists that the denudation of the mountain slopes has had some adverse effect on the air currents and that this also tends to cause a lesser amount of precipitation. The problem of re-forestation of the eastern watershed of the Rocky Mountains is one of major national importance and should receive the most serious attention of both Provincial and Federal Governments.

There are other aspects of the situation which deserve close attention, and these have mainly to do with the effect of windbreaks and local plantations. Some people claim that the planting of tree belts and hedges on a large scale would tend to prevent soil drifting and lessen evaporation. It is an obvious fact that windbreaks which have become established and which have attained a height of from 8 to 12 feet will break the force of the wind and thus give some protection to the crop for from 100 to 150 feet on the leeward side of it, but in order to be completely effective in controlling soil drifting it would mean that hedges of the height mentioned would have to be established every 10 rods at right angles to the prevailing wind. Granting that such a system of hedges would be effective in controlling soil drifting and to some extent would lessen evaporation by preventing hot winds from blowing along the surface of the ground, there remains the difficulty of getting these windbreaks established. First, there is the difficulty of getting a suitable material for a windbreak that is cheap, and secondly, in districts where they are most needed the danger of the young trees being smothered by tumbleweeds and drifting soil is a very real problem. Caragana hedges are probably the most suitable kind of hedge material for the dry areas, and the experience of many farmers has been that while it is not impossible, there is great difficulty in getting them successfully established under open field conditions. The value of windbreaks around the farm buildings and gardens cannot be over-emphasized, but it is not likely that such plantations have any other than a purely mechanical effect in holding the snow and preventing damage by abrasion. Their effect on the climate is not likely to be noticeable.

TREES AND EVAPORATION

Much has been said about the value of trees as a source of moisture through evaporation, but there is very little evidence of a conclusive nature to indicate that they give off more moisture than they take in through their roots. It is a well known fact that during the growing season trees give off a great deal of moisture through their leaves by the process of transpiration, and the theory is that by the establishment of large acreages of trees in the dry area, sufficient moisture would be given off into the air to substantially modify the humidity of the air and thereby increase the possibility of rainfall. There is no data available to show that this actually would happen; on the other hand there is a great deal of evidence to show that trees under prairie conditions consume a great deal of moisture and very often require that a strip of ground on each side be kept fallow in order to provide sufficient moisture to maintain the land in full vigour.

The proposed tree belt in the United States, when and if it is planted, will in no way be under similar conditions to that which obtain in the dry area of Alberta. The annual rainfall in the territory in which it is proposed to plant the tree belt varies on an average from 20 to 22 inches, or an amount which is slightly higher than the average rainfall of the Edmonton district. The United States Department of Forestry officials are convinced that the project would not be a success under the moisture conditions which obtain on the treeless plains, and consequently have moved the belt sufficiently far east to bring it into a belt where trees grow naturally. Trees have a place, but the success of any tree planting programme will be governed by the amount of annual precipitation available and it would seem that this amount must be in excess of 21 inches.

THE DRY AREA OF ALBERTA

Farming Practise

The history of settlement of the dry area of Alberta has been dealt with sufficiently in a previous section, and need not be repeated here, except to again point out that most of the area was either used for ranching purposes or was unused prior to the big influx of settlement in 1911. From 1911 to the outbreak of war in 1914, the invasion of this area by the wheat farmer was not serious, but from 1914 onwards the area was rapidly brought under the plow. The land was easily and inexpensively cultivated, the wheat produced was of exceedingly high quality, prices were good, and the bumper crops of 1915-16 made this area seem a veritable El Dorado. Practical experience over a period of years in the area soon showed that moisture was likely to be a limiting factor in preventing the use of long term rotations of cereals and grasses, such as was the common practise in more humid sections, and the result was to develop two short rotations, both of which were equally harmful in removing the fibre from the soil. The first and most common rotation was the two-year one of summerfallow and wheat, and the second, a rotation of three years consisting of wheat two years and summerfallow one. These rotations, and the fact that a suitably drought resistant grass was not available, meant that practically no fibre was returned to the soil, with the result that in the lighter, sandy areas such as around Youngstown, land drifted badly after a very few years of cultivation. Scarcity of natural water supplies, such as lakes and streams, and the inability to produce large quantities of forage made it difficult for the grain farmer to carry much live stock, and the general practise was to get along with the minimum number required for power and home consumption. In fact, it would not be putting it too strongly to say that many farmers did not keep sufficient live stock to supply household needs of milk, bacon and eggs. The vast majority of the stock kept was of very poor quality and decidedly inefficient from the standpoint of utilization of feed. Most of the cattle were of scrub dairy stock and were neither economically satisfactory for milk or beef production. Hogs were not grown to any extent and again the quality left much to be desired. Sheep, probably the most economical type of live stock to raise in the dry area, with the exception of poultry, were not raised to anything like the extent they could have been, and the small farm flock was the exception rather than the rule, although the numbers did increase materially subsequent to 1922. It has been agreed by many authorities that poultry are the most profitable and easily kept type of live stock to raise in the dry area and, even although market conditions were not such as to justify a large expansion of the industry, more profitable use might have been made of them as a means of supplying the family needs.

In the area along the Red Deer river, from Dorothy to Cessford, and along the Bow Slope, horse ranching was the major occupation, and as long as prices were good, yielded fair returns. Speaking generally then, it can be said that the main farm enterprise throughout the dry area is the growing of wheat and the farmers are almost entirely dependent upon it as a means of making a living. The low average yields mean that it is an extensive type of wheat farming with the average size of farm being 1122, 605 and 444 acres in Census Divisions 3, 5 and 7, respectively. The result of this type of farming, coupled with the dry conditions which normally prevail, has been a rapid depletion of soil fibre and a consequent tendency to soil drifting in the lighter soils, until to-day, wind erosion is a major problem in some districts.

SOIL DRIFTING

The problem of soil drifting is one of comparatively recent origin in the Province of Alberta, the first time it reached serious proportions was in 1920, when a triangle beginning at Pincher Creek, extending eastward and northward

to Grassy Lake on the south, and Retlaw on the north, a distance of approximately 100 miles, including 40 to 50 townships, or about one million acres of land, was seriously affected. Damage varied in this area from 2 to 75 per cent of the crop acreage. The most seriously affected area at this time was immediately west of Lethbridge, where about 75,000 acres were completely destroyed. Since 1920 the problem of soil drifting has become an increasing menace in all of the older settled districts of the Province, where special protective measures were not being taken to control it. In recent years, heavy drifting has been noted in the park belt soils north-west of Edmonton in the Villeneuve district and south and east around Millet and Camrose. The history of the drifting problem in all districts has been practically the same. As long as the land was new and contained a fair proportion of fibre, very little difficulty was experienced. After being grain-farmed for from eight to ten years, the land started to drift and with the coming of a period of dry years, the rate of erosion was rapidly accelerated, until whole districts were subject to the constant menace of drifting soil. During the past five years of dry weather, it is safe to say that soil drifting has developed into the most serious menace to the stability of western agriculture.

THE CAUSES OF SOIL DRIFTING

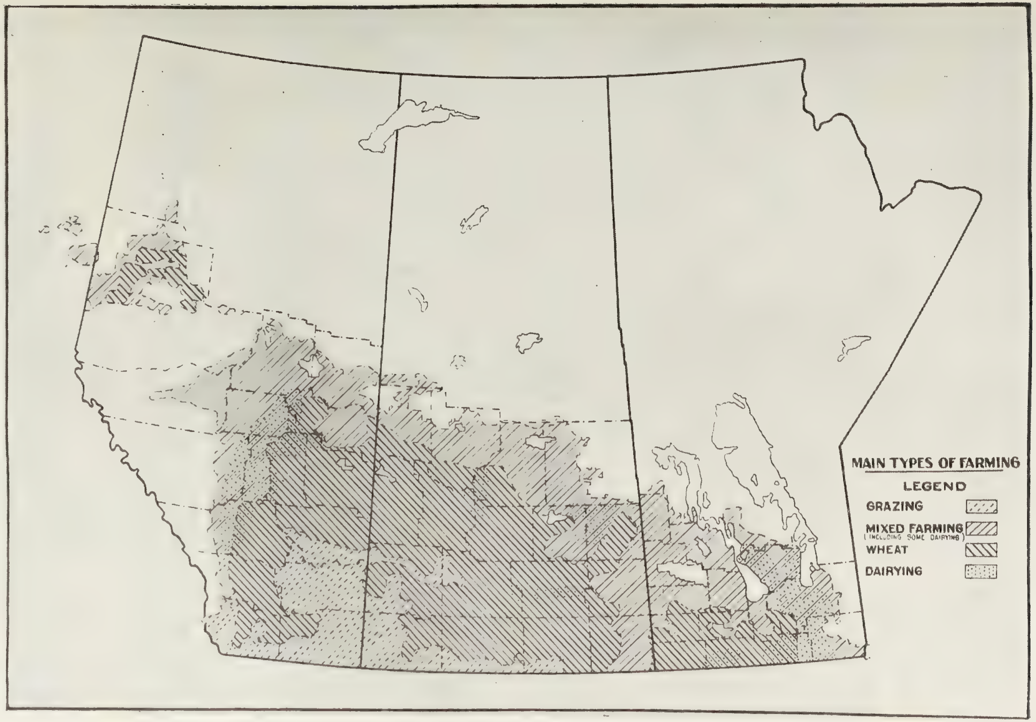
Soil drifting is not peculiar to the western plains, but is to be found in any area where rainfall is limited and high winds pass over dry soil which is in a fine state of cultivation. The system of crop rotation followed in the dry farming areas, whereby half the land is in summerfallow each year, provides the ideal condition for drifting when other factors are favourable and much of the damage from wind erosion must be atributed directly to the summerfallow system, but in view of the fact that summerfallowing is about the only means of conserving moisture and controlling weeds in the dry area some modification of the system is necessary. While insufficient rainfall, high winds and the cropping system are the general causes of soil drifting, the specific causes are:

1. Insufficient root fibre in the soil.
2. Lack of cohesion between soil particles.
3. High winds and pre-disposing climatic factors, such as insufficient rainfall.
4. Improper and untimely use of tillage machinery.

A result of a survey made in Manitoba in 1919 and reported in "The Proceedings of the Western Canadian Society of Agronomy 1920" (35) led the authorities to believe that root fibre was much more important than humus in controlling drifting. Soils with high ignition tests (high in humus) were often affected by drifting, but not a single instance was reported where soil drifted that contained a plentiful supply of root fibre. The condition or state of disintegration of root fibres appears to have a more direct influence on soil drifting than the total amount of organic matter contained. When fibres are decayed or broken down, they are of little value in maintaining the structure of the soil. When the root fibres have become broken down and converted into humus and when the humus in process of decomposition, has reached a finely divided state, aeolian (wind) separation takes place, due to the different degrees of motion imparted to the different soil constituents. It has been observed that sand dunes or banks on the headlands of fields are largely composed of mineral matter and the finely divided organic matter has apparently been dissipated into the atmosphere in the form of fine dust. By comparing the sand in the ridges on the headlands with the soil from the field from which the sand drifted, it was found that the organic matter content was much lower, because a great deal had been lost by deflation.

LACK OF COHESION BETWEEN SOIL PARTICLES

Lack of cohesion between soil particles has an indirect effect on the drifting of soil. First, because of the lack of cohesion and poor tenacity natural to sands, and secondly, there is the humus depletion due to continued cropping, resulting in a reduction of moisture holding capacity, which indirectly re-acts and pre-disposes soil to drifting. It was observed that where a clustered or cloddy condition of the top soil was maintained, drifting was reduced. In some soils, there is such a lack of cohesion that it is impossible to maintain a clustered or cloddy surface, and when improper use of tillage machinery is added to this condition, drifting is likely to be serious whenever conditions are favourable.



Courtesy Dominion Bureau of Statistics.

FIG. 5—For purpose of constructing this map, the National Development Bureau defined the agricultural system in areas where wheat acreage was greater than the combined acreage of all other crops as "Wheat farming"; where wheat acreage was less than that of all other crops, as "Mixed farming"; where the value of dairy products was equal to or greater than that of wheat, as "Dairying"; and where grazing leases predominated and wheat acreage constituted less than 16 per cent. of the total area, as "Grazing."

HIGH WINDS AND PRE-DISPOSING CLIMATIC FACTORS

Winds of high velocity acting in conjunction with a period of insufficient rainfall, will invariably lead to drifting in susceptible soils. Lack of sufficient moisture in the Summer months means that the natural tendency of soils to disintegrate is hastened and, at the same time, root growth is at a minimum development with the result that when soil particles start to move, the abrasive action of the sand particles soon breaks down whatever resistance there is. A further pre-disposing cause of drifting, particularly in the south country, is the lack of snow cover during the Fall and Winter months. Miles and miles of bare summerfallows provide an opportunity for an almost uninterrupted sweep, with the result that the abrasive action of the drifting soil is accumulative the further it progresses in any direction in a given area.

IMPROPER AND UNTIMELY METHODS OF TILLAGE

The fact that soils vary so greatly in composition and texture from district to district, has undoubtedly made the problem of a proper selection of the right tillage machinery to use a difficult one, but nevertheless, it appears that insufficient attention has been paid to the question of the best type of machines to use on different soils and the proper time to use them. Practical farmers who have been most successful in controlling soil drifting, always emphasize the value of timeliness of operation as well as the use of specific machinery. Tillage machinery so far, has been primarily designed for the control of weeds and while it is important that weeds be effectively controled, it should be remembered that certain implements are capable of performing that function with a minimum destruction of the granular surface of the soil. Generally speaking, the field cultivator is the most serviceable implement to use in areas subject to drifting, because it leaves the soil in ridges and also leaves a fairly good trash cover. The ordinary disc harrow on the other hand is one of the worst implements that can be used on old land and dry soil. While it is effective on new land and for shallow cultivation, it pulverizes the soil to a greater extent than any other implement in common use. At the same time, it must be pointed out that there are times when the soil is moist that this implement can be used effectively. The spike-tooth harrow is another implement that should be used sparingly on dry soil because of its pulverizing effect. Of the newer implements in common use, the one-way disc and the rod weeder, are two very effective machines, both from the standpoint of the destruction of weeds and drift control. The former is particularly useful as a substitute for the plow in summerfallowing, because it leaves a good trash cover of weeds and stubble and a cloddy or lumpy condition of the soil particularly if the operation is carried out under moist conditions. It is particularly effective for the first operation in heavy combine stubble, but should be used sparingly for subsequent operations lest the trash cover be destroyed. In thin binder stubble, it would probably be inadvisable to use the one-way because the scant stubble would be buried. The stiff-tooth cultivator and rod weeder would be more effective in this instance. The latter machine leaves the surface soil undisturbed while at the same time being effective in destroying weeds. When used after the cultivator or one-way disc, it makes a very satisfactory job of weed control without reducing the effectiveness of those machines for drift control.

One of the cardinal principles of weed control and drift control is the conservation of moisture and in order to do this, many farmers disc their fields early in the Spring in order to start the weeds growing before summerfallowing starts. This operation is followed up by carrying out subsequent operations when the soil is moist in order to leave a rough surface.

RESULTS OF SOIL DRIFTING

Soil drifting in its initial stages is not likely to affect a whole field at one time. The lighter areas and exposed spots usually start first and spread out fan-wise in an ever increasing radius, until eventually, the whole field and then adjoining fields are affected. It should be remembered that all soils will drift if they are in a fine, loose condition, but the types most likely to drift are the light sandy soils, and the heavy clays. Intermediate soils form clods readily and maintain a granular structure and the granules are held together more firmly when dry than moist. The light, sandy soils, on the other hand, break down and readily lose their granular structure under dry conditions. Heavy clay soils, although they have a granular structure and form clods, are reduced to fine particles with continued cultivation more readily than the loam soils.

According to Sloan (27), three conditions are involved during the process of soil drifting. The first and most conspicuous of these is the dust cloud composed of very fine particles which rises to great heights and under certain conditions, may be carried long distances. The second type of drift is composed of slightly heavier particles which billow along from five to fifteen feet above the ground. This drift will settle quite rapidly when the wind velocity drops below a certain point. The third kind of drift material, and the most important, consists of still larger particles which seldom rise more than a foot or two above the ground. These harsh particles cut off tender vegetation and, by their abrasive action, scour and break down adjoining soil which in turn. forms more drift, dunes and so on, While damage by abrasion is the most common type seen in grain fields, it is not uncommon to find whole fields and pastures that have been injured severely by the deposition of several inches of soil drift from an adjoining field.

The most important type of loss from soil drifting is the one that is least frequently recognized, namely, loss from the soil itself by deflation. The varying degrees of motion imparted to the soil by aeolian (wind) action causes the loss of a large amount of organic matter and available plant food which is dissipated in the form of fine dust. According to the Proceedings of the Western Canadian Society of Agronomists 1920 (35), this separation appears to take place very readily when the organic matter of the soil becomes disintegrated (burned out or rotted). Thus, though the decomposition of humus is beneficial as far as available plant food is concerned, it is very detrimental to that structural condition which is of prime importance in regard to soil drifting. As an example of aeolian separation and resulting loss of combustible matter in soil, a case is cited where loss on ignition tests were made by the Physics Department of the University of Manitoba.

The loss on ignition of drifting soil on a headland near Carberry was 5.9%.

The loss on ignition of soil from the field from which this drifted was 10.9%.

The loss on ignition of sand deposited on a field 2 inches deep was 5%, and the loss on ignition of soil from the field 2 to 6 inches below this sample was 12%. These tests indicate that a very large percentage of the organic matter is separated out and lost as a result of wind action.

More recent work done by Moss (22) in Saskatchewan indicates that the drifted material from heavy soils is practically identical in mechanical composition with the undrifted soil. The same is generally true for the values for pygroscopic moisture, loss on ignition, nitrogen and phosphorus. On the other hand, drift from the sandy soils has a much lighter texture and lower values for the above constituents than the undrifted soil. The drift from medium textured glacial types of soil is also lighter than the original soil, but is potentially more fertile than the drift from sandy soils.

It is very difficult to get an accurate picture of the actual monetary loss as a result of soil drifting. The loss of crop, the cost of the farming operations involved and the replacement of seed are costs that are readily known to the farmer, but actually these are only a small fraction of the actual loss which takes place. The greatest and most important loss is that of soil fertility. It has been variously estimated that the loss of one inch of the top soil in a good farming area is equivalent to the loss of sufficient plant food to produce 20 crops of wheat, each yielding 40 bushels to the acre. By continued wind erosion, first class farm land in many districts is rapidly being reduced to land of second-, third- and fourth-rate quality.

SOIL DRIFTING CONTROL

Soil drifting control measures are of two main types, one cultural and the other by crops, and it must always be borne in mind that these measures will vary with local conditions such as soil type and annual rainfall, and with the cropping system. In discussing remedial measures it would seem logical to start with those which should be used when erosion is first noticed. It will be recalled from a preceding section that wind erosion usually starts in small spots, generally the more exposed knolls and patches of lighter soil. As erosion continues, the affected area enlarges fanwise. That being the case, these are the sources of trouble which should be immediately checked. When the affected centres are small and not too numerous, a few loads of straw or manure may be spread lightly over the area. If these commodities are not available, several furrows may be plowed at right angles to the prevailing wind, at intervals of several feet apart. A lister or

duck-foot cultivator may be used with equal effect for the same purpose and the time spent in checking the spread of erosion at the point of incidence will always mean time and money saved later on. The next stage to combat is that in which erosion is going on more or less over the whole field. In this case, control becomes a definite matter of farm management and proper use of machinery. To begin with, stubble should not be burned unless it is absolutely necessary. The next item to decide is whether the fallow shall be made by the ploughed or ploughless method. If the plough method is to be used, it has been found to be sound practice to cultivate with a stiff-tooth cultivator once early in the spring to start weed growth and then give a second cultivation in June. Both operations should be shallow. The land is then ploughed fairly deeply about the middle of July and left in as cloddy a condition as possible. Where perennial weeds are prevalent and it is desirable to maintain a black summerfallow, subsequent operations after fallowing should be carried out as necessary with a duck-foot cultivator and rod weeder.

The Ploughless Fallow

Ploughless fallow is a development of recent years, the basic principle of which is the destruction of weed growth, while at the same time leaving stubble and other trash on the surface of the soil or mixed through it in such a manner as to prevent wind erosion. While this method has been most effective in controlling drifting in areas where it has been used, it is advisable to use it in conjunction with strip farming in order that large blocks of fallow land are not exposed at one time. In the case of heavy combine stubble the one-way disc is used for the first operation and sometimes the second, subsequent operations being carried out as necessary with the cultivator and rod weeder. It cannot be too strongly emphasized that no more cultivation should be given than is necessary to conserve moisture by destroying weed growth; otherwise the protective trash cover will be destroyed and erosion will be likely to result. In the case of reasonably short and clean binder stubble, the duck-foot cultivator can be used for the first operation and then the rod weeder should be used. The number of cultivations necessary will depend on the weed growth present and on the amount and frequency of rainfall. In districts where the pale western cutworm is a menace, care must be taken to have the summerfallow in such condition that it will be unnecessary to touch it during August and the first half of September. Generally speaking, the last operation in the fall should be carried out with the cultivator so as to leave the land in a ridged and cloddy, trashy condition. If drifting starts during the winter or early spring, it can be checked by spreading straw or manure as described previously, or by using an ordinary single disc while the land is wet enough to puddle or be thrown up in clods.

Strip Farming

Much has been said in the last few years about strip farming as a control measure for soil drifting, but it must always be borne in mind that strip farming is only one control measure, albeit a very useful one, and that best results will only be obtained by its use in conjunction with other recommended cultural practices. According to Hopkins et al (12) "stripping is usually started on a field in the year when it is to be fallowed, by dividing it into strips of the desired width, seeding alternate strips to spring grain and leaving the other strips to be fallowed. This arrangement of strips is to be followed where the practice is to summerfallow every other year. If the land is to be fallowed only once in three years two strips should be seeded to spring grain and the third one fallowed. Another method of strip farming is to seed the stubble land in the strips in the fall to fall rye. The following year the fall rye may be cut for grain or hay while the intervening strips are summerfallowed. If it is not desired to seed wheat on all of the summerfallow, strips of fall rye might be seeded in the fall of the year the land is fallowed, the crop being cut for grain or hay; or strips might be seeded in the spring for green feed, intervening strips being sown to wheat. In both cases, the strips of fall rye should be ploughed immediately after the crop is removed, so as to provide a partial summerfallow. These latter methods of commencing strip farming are not considered as generally satisfactory as the method first outlined, but are suggested as alternatives in order to meet various local conditions. The width of strip to be used will depend on the seriousness of the problem on the individual farm, but it will usually be found that the strips should not exceed 20 rods in width and may be as narrow as 5 rods, with 10 being very common. The strips are usually laid out in a north and south direction, thus being approximately at right angles to the prevailing winds. Sometimes, in districts where drifting is severe, some soil from the summerfallowed strips will drift into the edge of the grain field and form a ridge in the stubble. This difficulty is overcome by discing or flattening about 40 feet of the stubble on the west side of the field, thus permitting the drift, if any, to be distributed evenly over the area. Sloan (27) of Montana briefly summarizes the advantages and disadvantages of strip farming very well as follows:

Advantages

1. Prevents soil blowing (when used with other practices).
2. Insures a 50-50 proportion of fallow and crop.
3. Encourages a better type of farming.
4. Provides for a variety of crops in the same field without inconvenience.
5. Makes it convenient to provide for a pure seed lot.
6. Allows operator to take advantage of uneven ripening in different parts of the field and reduces the hail hazard.
7. Is practical for large units operated with large type machinery.

Disadvantages

1. Requires more turning and leaves more corners to work out.
2. May mean loss of some land at ends of strips.
3. Some ridges may be formed along west side of stubble strips if strips are too wide (may necessitate moving strips eastward a few rods).
4. Sometimes necessary to destroy a strip of weeds in the fall along the west side of stubble strip (this can be largely obviated by back furrowing along grain when plowing fallow strips).
5. Leaves more borders to poison in case of a grasshopper infestation.
6. Operating costs slightly higher.

One phase of soil drifting that has been particularly unpleasant during recent years in seriously affected districts has been in those cases where drifting soil has invaded the farmstead, covering lawns and shrubs and infiltrating into the houses. Suggested preventive measures are the sowing and maintenance of at least a 20-rod strip of pasture land on the side of the farm buildings from which the prevailing wind comes. This seeded strip should be outside the farm shelter belt and as an added protection a second shelter belt of caragana or Russian poplars may be planted outside the pasture. During the interval while the trees are becoming established sunflowers may be used to give protection.

Cover Crops

Cover crops, consisting of spring grains sown about August 1st at the rate of half a bushel per acre, provide a very effective control for soil drifting on summerfallows in districts where rainfall is above the average. The method is used quite effectively along the Aldersyde line of the C.P.R., south to Claresholm and along the foothills, but does not extend east of Barons. Either wheat, oats or barley can be used for the cover crop and after being killed by the frost the crop is very effective in checking drifting during the fall and winter months.

It should always be recognized that soil drifting is a community problem. Every farmer who has land which is subject to drifting, is under a social and moral responsibility to the community in which he lives to control erosion on his farm, and it is in recognition of this principle that soil drifting control legislation has been enacted in Alberta. By taking proper community action together with the practice of strip farming and proper and timely cultural practices, the problem of soil drifting in Alberta can be solved.

FARM MANAGEMENT PRACTICES IN THE DRY AREAS

Types of Farming

Generally speaking, three types of farming are practised in the dry area of Alberta. The first and most important of these is the type carried on by the dry farmer who depends almost entirely on the growing of wheat as a means of making a living. The second is the farmer-rancher who grows a certain acreage of wheat, but who also tries to combine ranching as a secondary enterprise; and the third is the rancher proper. A small fourth group, whose main enterprise is ranching, but who farm in a limited way, might also be included as rancher-farmers.

The Dry Farmer

Crop districts 3, 5 and 7 in Alberta, lie within what might be termed the permanent drought belt of the western prairies because some part or all of these districts is affected by drought during a great portion of the time. The area contained a population of 79,823 persons at the time of the 1931 census, and included 16,469 farms. The average size of farms was 1,122,605 and 444 acres respectively in crop districts 3, 5 and 7. Approximately 83% of the cultivated acreage on these

farms was devoted to the growing of wheat and 17% to other crops, mainly oats used for feed for the horses and other live stock which were kept. The farms averaged approximately 10 horses, 17 cattle, 4 hogs and 12 sheep each when ranches and all were included. Actually, there are many farms on which there are no live stock whatever outside of the necessary horses to supplement tractor power and one or two cows. The five-year average production (1929-1934) of wheat in this area was 22,920,078 bushels. If the average net price per bushel received by the 16,469 farm operators for this wheat over the five-year period was 50 cents, it would mean that the cash return per farm was $696.49. Out of this amount, seed, taxes, machinery, interest and living expenses had to be paid. In other words, the average return from wheat on the farms in this area during the five-year period 1929-34 was slightly less than $1.00 per acre of land owned. What applies in crop districts 3, 5 and 7, also applies to some extent to the south-east corner of district 6, a strip on the east side of district 4 and the northern portion of crop district 1, east of Taber. Each year, since 1918, the taxpayers of the Province have been called upon to provide relief for dried-out farmers in this area in varying amounts. The sum total spent for relief by the Province in this area in the 17 years since 1918, is approximately ten millions of dollars. This would indicate that this area is a permanent fringe area in the economic sense and unless some re-organization takes place, it will continue to be a liability to the taxpayer of the Province. The extensive type of wheat farming followed in this area has meant a large investment in farm machinery, with a correspondingly high mortgage debt. Figures supplied by the Sanford Evans Statistical Service (10) showing the average mortgage debt per farm and per acre for the year 1931 in Census Divisions 3, 5 and 7 are shown in Table 1.

TABLE I—Mortgage Indebtedness, 1931

Crop District No.	Total Debt All Farms	ALL FARMS		MORTGAGED FARMS	
		Average Per Farm	Average Per Acre	Average Per Acre	% Debt to Value of Property
3	$16,566,629	$6,015	$5.36	$21.27	68.52%
5	11,477,148	1,921	3.17	6.74	42.91%
7	15,696,029	2,028	4.57	8.07	40%

These figures indicate that the average mortgage debt per acre in crop district No. 3 is $21.27 per acre, as compared with the average debt of all farms within the area of $5.36 per acre. Crop district No. 3 is the worst of the three from the standpoint of high average indebtedness per farm and per acre, the land being mortgaged to 68.5% of its total value in the former, as against 43 and 40% respectively in districts 5 and 7. This high mortgage debt in district 3 is accounted for by the large amount of irrigation land in the Brooks project which is included. In many cases the mortgage debt against the land is several times the value of the land and there can be no possibility of the debt being paid under a wheat farming or any other programme.

When the average yields of wheat per acre in the area are converted into terms of total production value, it will be seen that the area cannot maintain the type of farming that has hitherto characterized it, and furthermore, when average annual yields are co-related with average annual rainfall records over a long period of time, it is possible to arrive at a fairly accurate estimate of what the productive capacity of the area is likely to be in the future.

It was pointed out in a previous section, that annual and average rainfall figures are only interesting as an indication of what the general crop situation is likely to be over a long period of years. The figures that are significant are those that are provided when annual rainfall records are corelated to crop yields and the yields in turn translated into terms of production value. This is done in Table II. and it partly provides the reason for the unsatisfactory economic condition which prevails in the dry area to-day.

TABLE II—Showing Corelation of Precipitation Records, Crop Yields and Production Value

		MEDICINE HAT				BROOKS			HANNA				THREE HILLS		
Year	Price per Bushel	Precipitation April, May, June, July	Annual Precipitation	Yield per Acre	Production Value per Acre	Annual Precipitation	Yield per Acre	Production Value per Acre	Precipitation April, May, June, July	Annual Precipitation	Yield per Acre	Production Value per Acre	Annual Precipitation	Yield per Acre	Production Value per Acre
1910	0.79	2.6	7.5	7.0	$5.53	....	....	....	....	....	....	....	....	....	....
1911	0.64	8.3	16.4	18.2	11.64	....	....	....	....	....	....	....	....	....	....
1912	0.62	4.7	10.3	15.5	9.61	....	....	....	....	....	....	....	....	....	....
1913	0.67	7.1	13.6	11.1	7.43	....	....		7.10	13.6	17.9	$11.99	....	....	....
1914	1.22	2.8	12.1	3.2	3.90	....	....		2.8	12.1	8.8	10.73	....	....	....
1915	0.91	10.9	16.1	37.4	34.03	....	....		10.9	16.1	40.3	36.67	....	....	....
1916	1.31	10.7	17.9	23.3	30.52	....	....		10.7	17.9	29.1	38.12	....	....	....
1917	1.94	3.3	11.1	20.0	38.80	....	....		3.3	11.1	18.0	34.92	....	....	....
1918	2.02	3.5	10.1	2.9	5.85	....	....		3.5	10.1	5.3	10.70	....	....	....
1919	2.37	3.7	7.6	2.3	5.45	....	....		3.7	7.6	5.5	13.03	....	....	....
1920	1.62	5.4	10.7	7.7	12.47	....	....		5.4	10.7	15.7	25.43	....	....	....
1921	0.81	6.7	11.7	7.1	5.75	....	....		6.7	11.7	7.9	6.39	....	....	....
1922	0.85	6.5	11.3	9.2	7.82	....	....		6.5	11.3	6.7	5.69	....	....	....
1923	0.67	....	13.6	20.8	13.93	11.3	....		9.7	13.6	20.8	13.93	7.5	....	....
1924	1.22	....	9.8	6.0	7.32	....	....		1.6	9.8	6.0	7.32	13.1	....	....
1925	1.23	....	14.6	10.0	12.30	14.1	20.0	$24.60	7.6	14.1	20.0	24.60	13.1	25.0	$30.75
1926	1.09	....	11.9	5.0	5.45	10.2	15.0	15.75	3.6	11.9	15.0	16.35	17.5	20.0	21.80
1927	1.00	....	25.2	25.0	25.00	21.7	25.0	25.00	....	....	25.0	25.00	16.8	25.0	25.00
1928	0.80	....	7.6	25.0	20.00	11.5	20.0	16.00	....	11.6	20.0	16.00	14.5	25.0	20.00
1929	1.05	....	9.3	10.0	10.50	9.1	5.0	5.25	....	8.9	5.0	5.25	8.5	5.0	5.25
1930	0.49	....	12.7	10.0	4.90	13.0	20.0	9.80	....	13.4	10.0	4.90	8.1	5.0	2.45
1931	0.38	....	9.9	5.0	1.90	8.7	20.0	7.60	....	....	5.0	1.90	14.0	10.0	3.80
1932	0.30	....	16.5	15.0	4.50	14.2	20.0	6.00	....	11.9	15.0	4.50	21.2	25.0	7.50
1933	0.41	....	14.1	5.0	2.05	12.7	20.0	8.20	....	8.5	5.0	4.05	10.9	10.0	4.10
1934	0.53	....	13.0	10.0	4.10	9.6	10.0	5.30	....	....	5.0	2.65	9.2	10.0	5.30
Average of years given	0.99	....	12.5	12.3	10.65	12.3	17.5	12.35	....	11.8	13.9	14.55	12.8	16.0	12.59
SUMMARY 6-YEAR PERIOD, 1929-1934		MEDICINE HAT				BROOKS			HANNA				THREE HILLS		
	0.52	...	10.9	9.1	$4.65	11.2	15.8	$7.02	....	10.6	7.5	$3.87	10.3	10.8	$4.73

To begin with, the number of points for which precipitation and yield records are available is not sufficient to give an accurate picture of the actual situation. Added to this difficulty, is the further one that the points for which records are available are not the points at which the most serious drought conditions have prevailed; in fact, the conditions prevailing at the points recorded, tend to point an altogether too optimistic picture, but failing other data being available, use is made of existing records to give an indication of the situation. The points for which records are available in the dry area, are—Medicine Hat, Brooks, Hanna and Three Hills. Anyone familiar with the area will readily recognize that conditions at Youngstown are, as a rule, worse than those at Hanna and, similarly, that conditions at Brooks are better than conditions at Jenner, particularly when it is remembered that the average yields quoted at Brooks include grain grown on irrigated land.

Precipitation and yield records for the Medicine Hat district, for the 25-year period 1910-1934 show that average annual precipitation was 12.5 inches, while the average yield was 12.3 bushels. During this period, the average price of wheat was 99 cents and the average return per acre $10.63. The record also indicates that one inch of precipitation produces on the long-time average, slightly less than one bushel of wheat. At Brooks, records covering the 10-year period 1925-1934, show the annual precipitation and average yield to have been 12.3 inches and 17.5 bushels, respectively, while the production value per acre was $12.35. Grain produced on irrigated land undoubtedly is responsible for the relatively high average yield in this district.

At Hanna, the average rainfall over the 21-year period 1913-1934, was 11.8 inches and the average yield 13.9 bushels. In this case, one inch of rain was equivalent to slightly more than one bushel of wheat per acre. Production value per acre, over the same period, averaged $14.55.

Records at Three Hills, which is on the north-western edge of the dry belt, covering the 10-year period 1925-1934, show that average annual precipitation and yield were 12.8 inches and 16 bushels, respectively. Here is a clear indication of the greater effectiveness of rainfall in a more northerly and westerly district, one inch of rain being equivalent to almost 1¼ bushels of wheat.

The table indicates very clearly that, as long as wheat prices were in the neighborhood of $1.00 per bushel, the farmer received a fair return per acre even when yields were low. On the other hand, the devastating results of a combination of low yields and low prices at the same time, are shown in the six-year summary from 1929 to 1934, for the same points. During this period, the average price of No. 1 Northern wheat was 52 cents per bushel, the average yield at the four points was 9.1, 15.8, 7.5 and 10.8 bushels, respectively, and the average production value per acre, $4.65 at Medicine Hat, $7.02 at Brooks, $3.87 at Hanna and $4.73 at Three Hills. During this period, one inch of rain was equivalent to approximately 9/10 of a bushel of grain at Medicine Hat, 1¼ bushels at Brooks, ¾ of a bushel at Hanna and 1 bushel at Three Hills, in very striking form.

Average figures as a rule, tend to show the best aspect of a situation because it covers up the numerous individuals in the community who, in a number of years, received no crop at all on much of their sown acreage, a condition which has been all too prevalent in the dry area. The record does indicate that over a long period of years, the farmer in the dry belt must expect to operate under conditions of recurrent periods of deficient rainfall, and that he must be prepared to finance his farming operations on the basis of approximately 12 bushels per acre of wheat, over a long period of years. Unless he can do this he is certainly fore-doomed to failure.

A detailed economic survey carried out in the Hilda, Irvine and Bow Island-Foremost districts in the summer of 1931 by Craig et al (9), under the direction of the Canadian Pioneer Problems committee, gives a very clear picture of the situation in average dry farming districts within the drought area. An analysis of the data gathered from 57 farms in the Hilda-Irvine districts revealed that the average number of acres in crop was 366. The average capital investment per farm was $14,540.00, made up as follows:—land, $8,602.00; buildings, $2,342.00; machinery, $2,422.00; live stock, including horses, cattle, sheep, swine and poultry, $1,129.00, and feed and seed, $45.00. The average cash receipts from these 57 farms in the crop year 1930-31, was $1,566.00, plus $278.00 increase in inventory, making a total average receipt of $1,844.00. Against this, there was an average cash expenditure per farm of $2,032.00, made up of $1,158.00, general farm

expenses; $640.00, capital expenditure and $234.00, decrease in inventory, leaving a net deficit of expenses over income of $188.00 per farm. If to this amount is added wages of the farm operator, valued at $569.00 and interest on the capital investment at 6%, there is a total deficit of $1,628.00 on the years operations as compared with an alternative use for the capital and the operator's time. Aside altogether from these latter considerations, however, there was a net loss per farm on operating expenses of $188.00, with the operator giving his time and the use of his money for nothing. In the Bow Island-Foremost districts, analyses of the data from 87 farms revealed that the average number of acres in crop was 669 and the average capital investment was $15,124.00, made up as follows:— land, $8,829.00; buildings, $2,362.00; equipment (machinery), $2,821.00; live stock, $907.00 and feed and seed, $115.00. The average cash receipts from 87 farms in the crop year 1930-31, was $1,894.00, made up of cash, $1,649.00 and increase in inventory, $245.00. Against this, there was an average cash expenditure of $2,345.00, made up of general expenses, $1,291.00; capital expenditure, $590.00, and decrease in inventory, $464.000. From this, it will be seen that there was a net cash deficit of $451.00, without charging in wages for the operator and interest on his investment. When the latter items are added, there is a gross deficit of $2,082.00, or in other words, there was a net loss on invested capital of 7.7% in the Bow Island-Foremost area as against 5.2% in the Hilda-Irvine area, thus indicating quite clearly that the larger the farm enterprise, the larger the deficit under the conditions which prevailed in the crop year 1930-31. The Bow Island-Foremost districts are definitely better than the average districts to be found throughout crop districts 3, 5 and 7, and this will explain in part the reason for a somewhat higher return than was indicated in the preceding section dealing with the average returns from wheat over the three crop districts. In the latter case, no detailed study was made and the figures are simply compiled from the 1931 census returns. In any case, the differences between the general statement applying to crop districts 3, 5 and 7, and the detailed statement in the Hilda, Irvine, Bow Island and Foremost districts, are only differences in degree of loss and, as such, serve to emphasize the seriousness of the problem of maintaining a farming population under dry farming conditions in this area. The figures obtained in the economic survey give a pretty clear picture of the investment in land, buildings and equipment, that the ordinary dry farmer is compelled to make. The amounts expended for buildings and equipment, including live stock, are by no means excessive; in fact, an average of less than $2,500.00 for buildings and $3,000.00 for machinery and $1,000.00 for live stock on farms operating between 200 and 900 acres is decidedly low. On the other hand, it would appear that the investment in land is altogether too high when considered in the light of the returns the farmer receives for his labour. If this is admitted, it would seem that a drastic downward revision of land costs will have to be made and this will undoubtedly involve a very great amount of writing down of mortgage indebtedness, because a large amount of the capital investment in the land is represented by mortgage claims of one kind or another. If any doubt is entertained in the matter, a statement of production costs per acre and the average living costs per farm will serve to make the point clear.

The average number of acres in wheat on 57 farms in the Hilda-Irvine districts in the crop year 1930-31 was 225, and in the Bow Island district, 323. The number of bushels sold per farm was 2,253 and 2,356, respectively, or an average of approximately 10 bushels and 7 bushels per acre. The net cost of producing each acre and each bushel of wheat sold, without including interest on invested capital or wages for the operator, was $9.00 per acre and 90 cents per bushel in the Hilda-Irvine districts and $7.25 per acre and $1.00 per bushel in the Bow Island district. When interest on invested capital and wages for the operator were charged, the costs were $11.66 per acre and $1.16 per bushel, and $9.51 per acre and $1.35 per bushel, respectively. On the other hand, the receipts from wheat sales per acre and per bushel were: Hilda-Irvine, $4.47 per acre and 44 cents per bushel, and Bow Island, $2.09 and 44 cents, approximately. From this it will be seen that there was a net loss per acre of $4.55 in the Hilda-Irvine districts and $4.16 in the Bow Island district, when interest on capital and wages for the operator were not charged. When these charges were added the loss was $7.19 and $6.42, respectively, for every acre of wheat grown. A study of average family living costs in these districts for the same period is no less illuminating and is shown in Table III.

TABLE III—Cost of Living on Farms at (1) Hilda and Irvine, (2) Bow Island and Foremost, Alberta, Survey of the 1930-31 Crop Year

	57 Farms at Hilda and Irvine, Alberta			57 Farms at Bow Island, Alberta		
	Average Per Farm	Average Per Adult	Per Cent of Total	Average Per Farm	Average Per Adult	Per Cent of Total
Cash Expenditures:						
Groceries and meats	$310	$66	37.0	$311	$85	33.2
Farm products bought	7	1	0.8	16	4	1.7
Clothing	149	31	17.8	136	37	14.5
Household operating	65	14	7.7	60	16	6.4
New household equipment	24	5	2.9	28	7	3.0
Hired help for home	9	2	1.1	16	4	1.7
Health	50	10	6.0	78	21	8.3
Education	23	5	2.7	50	14	5.3
Auto family use	62	13	7.4	64	17	6.8
Personal	54	11	6.4	86	23	9.2
Life insurance	65	13	7.7	74	20	7.9
Church	21	4	2.5	19	5	2.0
Total cash expenditures	$839	$175	100.0	$938	$253	100.0
Value of use of house	$120	$25	34.0	$140	$38	40.5
Value of farm products consumed	165	35	46.7	149	40	43.1
Value of live stock used	68	14	19.3	57	15	16.5
Total non-cash cost of living	$353	$74	100.0	$346	$93	100.0
Total cost of living	$1,192	$249	....	$1,284	$346	....

From this table it will be seen that the average cash cost of living on 57 farms in the Hilda-Irvine districts was $839.00 per farm or $175.00 per adult person, while in the Bow Island-Foremost districts the costs were $938.00 per farm and $253.00 per adult person. The difference in costs may be explained in part by the fact that the farmers in the Bow Island-Foremost section bought more groceries, meats and farm produce than those in the Hilda-Irvine districts. The latter grew a larger proportion of their household needs on the farm. The Bow Island-Foremost districts also spent slightly more for hired help, health, education, insurance and personal expenses, which would indicate that there is probably a slightly higher cultural standard in those districts than in the former. Sufficient evidence has been provided to show that the situation in which the dry farmer in the drought area finds himself is not a particularly happy one. This is particularly true when it is considered that the districts for which detailed statistical data have been provided, are distinctly better than the average for the area. A similar economic survey for the whole drought area would disclose a shocking situation from the economic standpoint and, without a sound economic basis, there can be no pretense at maintaining social and cultural standards.

The Farmer-Rancher

The farmer-rancher is to be found scattered here and there throughout the dry area, with a tendency to a concentration of numbers along the banks of the Bow, Red and Saskatchewan rivers and in the northern part of crop district 1. Generally speaking, he is to be found on the poorer types of farm land or at best his land will be of a less uniform quality than that of his neighbour, the dry farmer. What has been said about the dry farmers operating costs applies with equal or greater force to the farming operations of the farmer-rancher. There

is, however, the added difficulty in the case of the farmer-rancher that, when he loses his crop through drought, he is in a much more serious situation than the straight wheat farmer, because he is faced with the responsibility of either securing feed to carry his stock over the winter or selling them in poor condition at a sacrifice. This type of man has been a shoe-string operator attempting to carry a bigger load than his resources justified. His cattle were often of inferior quality and this, coupled with an insufficient supply of pasture and feed, meant that returns were disappointing when he was forced to market his stock as a result of feed shortage. The unloading of large numbers of under-finished, low quality cattle always has a demoralizing effect on the market with the result that the man with good stock is penalized as well as the man with the poor stuff. Generally speaking, the farmer-rancher has paid less attention to the management side of his enterprise than any other type of operator. There has been less uniformity in the quality of stock, less heed paid to a well defined programme of feed production and less thought given to efficiency in the utilization of feed by this type of operator than by any other. As an example of the methods followed by many of the smaller operators in particular, it is common practice to graze pastures to the limit and trust to the crop to provide sufficient feed to carry the stock over winter. When the crop fails, these men are a relief problem. In many cases, when relief feed has been applied for, it has been found that some of the operators were carrying over non-breeding stock that was three and four years old. On the other hand, it would be unfair to say that all farmer-ranchers are of this type. There are operators among them who, by the use of proper management practices, get by fairly well and seldom find themselves in the position of needing relief. These men make a practice of buying up the older range cows from the ranchers at a fairly low price and winter them through on the stubble and straw as cheaply as possible. In the spring the cattle are pastured on grass land adjoining the farm or on a community lease. The calves run at foot all summer and are sold as feeders off the grass in the fall because the operator has insufficient feed to carry them over winter. The cows are brought back to the farm and wintered through as before. Experience has shown that this is a fairly safe way to handle the situation because the farmer is always in a mobile position, he has not much money tied up in the cattle and he can get out of the business on short notice if he has to.

Sheep have a very definite place in the programme of the farmer-rancher and can be carried through more economically than any other type of live stock. This has been well demonstrated in the Hanna area since 1922 and a good many farmers in this region have been able to get by as a result of having a good-sized flock of sheep. In the spring the sheep maintain themselves on the stubble of land cropped the year before and are helpful in keeping down weeds on the summerfallow. They are more efficient in the utilization of feed of poorer quality than cattle and the lamb crop can be disposed of in the same manner as the calf crop in the case of the man who is running cattle.

Horses have proved to be a fairly satisfactory side line for the farmer in the dry area and, during recent years, more horses have been sold out of the Hanna and adjacent territory than from any other territory in Alberta. In a country where surface water is scarce, the ability of horses to travel further than any other live stock for their water supplies has been a distinct advantage and it would seem that, with more care given to a practical programme of feed production and conservation, the breeding of horses might continue to make a successful farm enterprise possible in this area.

The Rancher

Thirty-five years ago, most of the inhabited area of the Province of Alberta was inhabited by ranchers. It was then a country of ranches and one of the finest in the world. At that time, there were over 500 head of horses and 300 head of cattle for every 1,000 acres in field crops and 70% of the country's income was derived either directly or indirectly from live stock. By 1925 the situation had been reversed and 75% of the income in Alberta was derived from cereals and only 25% from live stock. Alberta range lands are of two distinct types—the long grass country of the western foothills and the short grass plains of south-eastern Alberta. Both types of grass are well suited to grazing and the cost of raising a steer is about the same, although the factors entering into the production costs differ. The cattle in the long grass plains, and the foothills cattleman, generally, has a longer winter feeding period than his neighbour further east. On the other hand, the rancher in the short grass plains, very often has a water problem on his hands, which greatly adds to his production costs. As it is with the rancher in the short grass plains that we are mostly concerned, nothing further need be said about the industry in other

parts of the Province. Ranching in Alberta, outside of the foothills region, is mainly concentrated in the south-eastern corner of the province, including most of crop district 1, and some of crop district 3, with a few scattered ranches in districts 5 and 7. Generally speaking, the industry is well organized and well managed. In spite of years of drought and demoralizing prices, the stockmen of southern Alberta have carried on with very little aid from the public treasury in the form of feed relief. One of the major reasons for this is that most of the ranches are quite large enterprises and are in charge of men who have made a special study of the business and who believe firmly in the principle of building up a strong operating reserve of feed supplies as an insurance against shortage at some future time.

The range lands of the short grass plains are well suited to the ranching industry wherever they are well supplied with water, but where natural supplies are not available, the cost of providing it greatly increases production costs. In many cases, the development of a suitable water supply is the most important and the most expensive part of the ranch equipment, the cost in some cases running as high as $15,000.00. Next in importance is the grazing capacity of the range and this varies throughout the dry area from 40 acres per head to as low as 120 acres, as the minimum acreage required to provide pasture and feed for each head of stock by one year. A few years ago, the Gilchrist Cattle Co. of Wildhorse estimated that their grazing requirements were 120 acres per head, but in this particular instance, the land had been previously badly over-grazed and there was practically no grass at all. Where good grass is available, it forms the very best kind of feed, not only in the summer, but in the winter months as well, and in mild winters, it is common practice to graze or "browse" the cattle through the winter on the grass with pasture supplemented by feed only during the cold spells and when the snow cover is too deep for grazing. The ranchers, generally, figure on from ¾ to 1 ton of hay per head for winter feeding as being a sufficient security against loss. In many cases, they have gotten by with as little as ¼ to ½ ton and still maintanied the cattle in weight. The aim is rather to provide a maintenance ration during the winter months than to put on weight. Experiments conducted at the Manyberries Station showed that there was no difference the following fall between long yearlings that had been fed a maintenance ration and those that were fed a ration sufficient to make them gain 80 pounds in weight during the winter months. The chief feeds grown in the dry area, are oat hay, rye hay, wheat hay, prairie hay, slough hay, sweet clover, alfalfa and corn fodder, and according to Thompson (30), it has been found that oat hay cut in the dough stage, is a very superior type of feed for wintering all ages of cattle. For mature beef cows, spring rye has proven to be a very satisfactory forage, while fall rye cut in the early dough stage has also proven very palatable. Surplus stocks of feed are carefully preserved and carried over from one year to another and in this respect, the rancher has set an example which might be profitably followed by every other type of farmer.

The production of winter feed in the range area usually amounts to about 20% of the cost of producing the calf, the ranchers generally figuring that their hay costs them about $5.00 per ton before it goes into the stack at all. The calf crop is the harvest in the cattle country and in Alberta the percentage increase is between 65 and 75% annually, as compared with 55 to 65% in such cattle states as Wyoming, Texas, Colorado, Oregon and Montana. The percentage of increase each year has a great deal to do with the production cost and in this respect Alberta is again in a favourable position. The cost per calf, as taken from the audited accounts of several ranchers running 1,000 head of cattle, is $35.33. This compares with costs of $38.00 in California, $41.82 in Oregon, $40.37 in Texas and $37.00 in Wyoming. Considered from every angle, it would appear that the rancher in the dry area has been the most successful of the three main types of settler found there. Although he undoubtedly has the advantage of using the land for the purpose for which it is best suited, he also must be credited with being more systematic and bringing a greater degree of sound management to his enterprise than either of his neighbours, the dry farmer or the farmer-rancher.

The Size of the Farm Unit and Its Relation to Community Life and the Maintenance of Social Services

The social and community life as well as the cultural standards of any given agricultural region are likely to be profoundly affected by the system of land tenure and its physical organization into holdings. The early communal type of agricultural settlement which dominated the agricultural regions of Europe in the 18th and 19th centuries, and still does in certain areas, was a system of

farming under which the farmers lived in villages and worked their holdings, which were usually disposed in strips at some distance from the village, by going to and from work night and morning. Under this system some of the land was used for the production of crops and some for community pasture. This system recognized the value of individuals living in close proximity to one another as an aid to human happiness, by satisfying the gregarious instinct in human nature. It also made possible the enjoyment of certain amenities such as community water supply, drainage, markets and so forth, which would not have been obtainable in any other way. The system has been abandoned in many parts of Europe, not because of a lack of appreciation of the advantages of communal life, but because of the unsoundness of having family holdings scattered in uneconomic strips throughout the community, a custom further aggravated by the inheritance procedure whereby the land was constantly being divided up among members of the family. At the same time, in breaking away from the communal or village type of agricultural settlement, many countries have tried to preserve as much as possible of the social value of community life by a system of surveys, whereby the homes are built along a central market road on farms that are comparatively narrow in proportion to width. In this way, with homes on both sides of the road, the distance between any two families is not great and the provision of such services as roads, telephones, electric power and mail service is comparatively simple.

The French habitants under the seignorial system in Quebec recognized three fundamental factors as being necessary to successful community life when they laid out their farms in long narrow strips facing the St. Lawrence, thereby providing close contact between neighbors, a good water supply and good drainage. In other words, aside altogether from economic factors, people have always recognized the social value of a type of settlement which permitted the greatest amount of social interchange. This is an historical fact which should be borne in mind when considering Canada's system of land survey established under the Homestead Act of 1862. The Homestead Act of 1862 introduced a uniform system of land surveys in Canada under which all of the unsurveyed land was surveyed into quarter section units of 160 acres and townships of six miles square. As a means of simply dividing land into parcels of uniform size, it has undoubtedly proven simple, efficient and economical. As a basis of settlement policy for the short grass plains, it was responsible in the first place for the Riel Rebellion and, secondly, for a great deal of economic maladjustment, human suffering and misery. The reasons for this are obvious. First, by its very nature, it cannot make allowances for the great variability in productive power of land and thereby cannot be sure of providing a satisfactory farm unit. Secondly, it cannot possibly make for the most efficient utilization of existing natural water supplies such as lakes, streams and reservoirs and, thirdly, it disregards entirely the social values of community life and the problems of the cost of supplying required social services. It is only fair to point out, however, that in regions where the soil is uniformly productive, where water supply is not a problem, and where markets which enable the farmer to maintain a reasonable standard of living are available, he may be able to make a good living out of the quarter section or half section farm. This undoubtedly applies in the case of the better mixed farming areas of park-belt soil, where an examination of statistics of settlement shows that the population density is usually between five and ten persons per square mile. Such population density is capable of providing a reasonable community life and, at the same time, carrying the tax burden necessary to provide required social services. On the other hand, where dry farming conditions prevail and the farmer is limited by conditions of climate and geography to the production of wheat as a cash crop, the 160-acre unit is decidedly too small and has practically never been used in the dry areas, the minimum being half a section and in the majority of cases, one or two sections. Where a farmer had a few head of stock and was using horsepower for his farming operations, one section of land was too small for a family unit, because it was impossible for him, one year with another, to have sufficient pasture for summer use, and land for the production of winter forage in addition to his cash crop of wheat. In other words, in order to maintain a minimum standard of living and to offset the years of low average yields, it is necessary for the farmer to have more than one section of land as a family unit in order to grow sufficient wheat for his cash needs and maintain sufficient live stock for household requirements. The actual situation that has developed, is that those farmers who have been able to maintain themselves in the dry area, are using three or four and in some cases, seven sections of land to maintain the family unit. They have their own holdings of one or two sections and are either using under lease or squatters rights, abandoned farms adjoining them, for pasture and forage purposes. The actual situation in the main dry area can be seen by looking at Table IV. which presents

a tabulation based on the 1931 census returns, showing the population in each Municipality or Improvement District in that area, the number of people and families per township, and the population density per square mile. From this table it will be seen that many townships contain as low as two or three families, while approximately 50% of the townships in crop districts 3, 5 and 7 have less than 20 families each. The population density in these same townships varies from as low as .1 persons per square mile to 2.8 in those having 20 families or less. A gradual increase in population density is to be noted in the northern townships of crop district 7, practically all having a density greater than 3 per square mile and 4 and 5 being quite common. All figures given here have been arrived at on the basis of population as given in the 1931 Dominion census returns and this means that in certain parts of the dry area, the figures are actually high because a large number of settlers have moved out since 1931.

TABLE IV—Showing Population in L.I.D.'s and Municipalities in Crop Districts 1, 3, 5 and 7. Also Number Persons and Families per Township and Population Density per Square Mile. (Computations on basis 1931 Dominion Census.)

No. and Name L.I.D. or M.D.	No. Twps. Per Unit	Population	Approx. No. Persons Per Twp.	Estimated No. Families Per Twp.	Population Density No. Persons Per Sq. Mile
L.I.D. 1	9	90	10	2	.2
L.I.D. 2	9	125	14	3	.3
L.I.D. 3	9	152	17	3	.4
L.I.D. 4	9	526	58	12	1.6
L.I.D. 5	9	1,097	122	24	3.0
L.I.D. 6	9	678	75	15	2.0
L.I.D. 31	9	38	4	1	0.1
L.I.D. 32	9	580	67	13	1.9
M.D. 33	9	477	55	11	1.6
M.D. 34	9	793	88	17	2.0
L.I.D. 35	9	307	34	7	1.0
M.D. 36	9	1,214	135	27	3.7
L.I.D. 61	9	808	89	18	2.1
L.I.D. 62	9	684	76	15	2.0
L.I.D. 63	9	570	63	17	1.7
M.D. 64	9	1,060	118	23	3.1
M.D. 65	9	1,148	127	25	3.5
L.I.D. 66	9	2,082	231	46	6.0
L.I.D. 91	9	1,115	124	25	3.0
M.D. 92	9	905	100	20	2.9
L.I.D. 93	9	852	95	19	2.8
M.D. 94	6	605	100	20	2.9
L.I.D. 121	9	452	50	10	1.4
L.I.D. 122	9	357	40	8	1.1
M.D. 123	10	209	21	4	0.6
L.I.D. 124	6	30	5	1	0.1
L.I.D. 125	10	713	71	14	2.0
L.I.D. 126	7	620	90	18	2.6
L.I.D. 151	9	1,097	122	24	3.2
L.I.D. 152	9	340	38	8	1.0
M.D. 153	9	135	15	3	0.5
L.I.D. 154	9	620	70	14	2.0
L.I.D. 155	12	772	64	13	1.8
L.I.D. 156	9	673	75	15	2.0
L.I.D. 181	8	1,304	163	32	4.2
L.I.D. 182	14	340	24	5	0.7
M.D. 183	10	473	47	10	1.5
L.I.D. 184	5	169	34	7	1.0
L.I.D. 185	10	1,634	163	33	4.2
L.I.D. 186	9	803	90	18	2.6
L.I.D. 211	8	548	68	16	2.0
L.I.D. 212	10	697	70	14	2.0
L.I.D. 213	9	398	45	9	1.4
M.D. 214	12	581	60	12	1.7
M.D. 215	8	316	40	8	1.1

TABLE IV—Continued

No. and Name L.I.D. or M.D.	No. Twps. Per Unit	Population	Approx. No. Persons per Twp.	Estimated No. Families Per Twp.	Population Density No. Persons Per Sq. Mile
M.D. 241	10	1,029	102	21	3.0
M.D. 242	9	1,103	123	25	3.3
M.D. 243	9	807	90	18	2.6
M.D. 244	9	704	80	16	2.8
M.D. 245	9	613	70	14	2.0
L.I.D. 246	7	1,180	170	34	4.3
M.D. 271	9	1,186	132	26	3.7
M.D. 272	9	1,227	136	27	3.7
M.D. 273 (Naco)	9	740	80	16	2.1
M.D. 274	9	788	88	18	2.1
M.D. 275	8	1,189	148	19	4.0
M.D. 276	8	2,178	271	54	7.5
M.D. 301	9	814	90	18	2.6
M.D. 302	9	941	100	20	2.8
M.D. 303	9	1,199	133	27	3.7
M.D. 304	9	796	88	18	2.2
M.D. 305	9	1,482	165	33	4.5
M.D. 306	9	1,651	183	37	5.0
M.D. 307	8	1,446	180	36	5.0
L.I.D. 331	9	1,180	131	26	3.7
L.I.D. 332	9	1,015	113	25	3.1
L.I.D. 333	9	1,255	140	30	4.0
M.D. 334	14	2,052	150	30	4.1
M.D. 335	6	707	101	20	2.8
M.D. 361	9	1,744	193	40	3.2
M.D. 362	9	1,200	133	27	3.7
M.D. 363	9	1,186	132	26	3.7
M.D. 364	10	1,683	168	34	4.5
M.D. 365	10	1,999	200	40	5.6
M.D. 391	9	1,475	166	33	4.5
M.D. 392	9	958	106	21	3.0
M.D. 393	9	1,233	136	27	3.7
M.D. 394	6	1,205	200	40	5.6
M.D. 395	7	1,814	259	52	7.0
M.D. 421	9	1,402	156	31	4.0
M.D. 422	9	1,674	186	37	5.0
M.D. 423	9	1,466	163	32	4.5
M.D. 424	6	1,237	206	41	5.5
M.D. 425	9	1,925	216	43	5.7
M.D. 455	9	2,121	236	47	5.8

TABLE V—Showing Number Families, School Children and Bachelors, Oyen Inspectorate, 1935

Municipal Unit	Name and No. School District	No. Families	No. Bachelors	No. Child. Grades 1-8	No. Child. Grades 9-12
	Hope, 4193	9	1	8	1
	Stonelaw, 2949	6	4	8	1
	Minor, 2552	9	2	14	3
	Gregerson, 3244	2	0	3	0
	Butte Vale, 2839	11	4	16	1
Stewart	Sedalia, 2859	4	2	8	1
M.D.	Shannon Heights, 4201	7	2	1	0
No. 302	Sounding Valley, 2838	5	3	3	1
	Berryfield, 2993	5	6	10	1
	Philo, 2396	8	0	1	0
	Roland, 2892	6	4	5	2
	Naco (Rural), 2656	3	3	3	4

TABLE V—Continued

Municipal Unit	Name and No. School District	No. Families	No. Bachelors	No. Child. Grades 1-8	No. Child. Grades 9-12
	Westside, 2401	9	5	7	3
	Highland Park, 2549	13	2	13	3
	Blair Gowrie, 2864	12	1	10	4
	University, 2981	8	2	5	3
	Glenada, 2651	8	1	7	3
Bertawan	Poplar Plains, 3121	7	3	7	3
M.D.	Wavy Plains, 2511	14	1	18	3
No. 271	Vernon, 3207	8	3	8	1
	Trinity, 3158	4	1	4	0
	New Haven, 4121	7	1	7	2
	Merrickville, 4114	12	5	18	6
	Esterdale, 4153	2	0	1	0
	Antelope, 3064	6	2	2	1
	Cherry Valley, 3087	3	1	8	4
	Clairmont, 3018	8	4	3	1
	Coe, 4381	7	3	8	3
	Douglas Lake, 3644	0	0	0	0
	Eastler Valley, 3887	0	0	0	0
	Ester, 4038	9	0	6	3
Canmer	Excelda, 3340	8	2	3	2
M.D.	Grenville, 3259	3	1	1	2
No. 301	Hudson Heights, 3716	10	7	6	5
	Little Eton, 3281	6	1	0	1
	Rush Centre, 2769	11	1	12	3
	St. Julien, 3578	9	5	12	4
	Saskalta, 2646	6	1	6	3
	Springville, 2697	10	2	4	2
	Wengers Heights, 3007	3	0	3	0
	Westland, 3888	9	1	6	3
	Nebalta, 3670	9	1	5	1
	N. Excel, 3909	3	1	9	3
	Fairacres, 2585	8	0	10	0
	Floradel, 2798	3	0	5	0
	Lovevale, 2643	0	0	0	0
	Farming Valley, 2796	11	0	12	2
Golden Centre	Craigmurry, 3202	4	1	4	1
M.D.	Golden Centre, 4028	6	2	4	0
No. 272	Longsdale, 2553	4	3	5	1
	Hollywood, 4188	5	2	2	2
	Riddellvale, 2700	7	2	3	1
	Cop Hill, 2701	16	3	30	2
	Wildflower, 2560	10	0	10	2
	McConnell, 3082	11	3	15	3
	Lawndale, 3099	5	4	5	0
	Bayfield, 4537	5	0	9	1
	Broadview, 2290	11	2	9	4
	Freda, 2403	11	1	7	2
Wiste	Kinnear, 3004	25	11	24	2
M.D.	Lawrence, 2468	10	3	8	1
No. 303	Lothian, 2622	8	4	13	2
	Rushmere, 3850	6	2	10	1
	St. Elno, 2561	8	2	6	1
	Westville, 3847	7	7	11	3
	Young Canada, 3153	2	0	2	0

TABLE V—Continued

Municipal Unit	Name and No. School District	No. Families	No. Bachelors	No. Child. Grades 1-8	No. Child. Grades 9-12
	Hills, 3224	9	6	3	3
	Abbott, 3002	5	3	2	2
	Kenmaul, 2800	16	5	20	2
	Springburn, 2994	12	4	10	2
	Kirkwall, 2463	11	4	13	0
Cereal	Fairweather, 3234	2	0	2	0
M.D.	Clarkson, 3221	3	1	5	0
No. 242	Lundberg, 2794	12	1	10	3
	Stimson, 2615	9	3	4	2
	Neilville, 3240	2	1	1	0
	Feadview, 2639	6	4	9	1
	Belle Plains, 3206	5	3	2	0
	Webster, 2592	6	3	5	2
	Cando, 2519	4	1	5	3
	Cloverleaf, 3115	6	1	3	1
	Collholme, 2572	10	3	7	1
	Heathdale, 2863	6	1	4	2
Collholme	Huggard, 4240	5	7	1	0
M.D.	Laughlin, 2423	5	3	1	0
No. 243	Myrtle, 3722	8	2	10	2
	Peyton, 2855	7	2	4	1
	Rearville, 3170	3	4	4	2
	Swan, 3441	6	2	4	5
	Empress View, 3571	4	2	3	0
	Cleveland, 3264	8	0	12	2
	Glevennah, 3195	6	5	11	1
	Stoneyhurst, 4060	8	1	5	2
	Bonnie Brier, 3023	9	3	5	2
	Grant, 2757	8	3	5	3
	Gravelhurst, 4169	11	4	22	3
	Wheatland View, 4059	10	3	7	
Acadia	Acadia Valley, 3078	24	7	27	6
M.D.	Graindale, 2702	8	1	8	4
No. 241	Stony Slope, 4426	10	1	8	5
	Carlyle, 3083	6	4	9	3
	Bounesdale, 4195	5	2	2	0
	Bryant, 2533	10	7	5	4
	Edendale, 2964	6	2	5	1
	Lonely Trail, 3260	7	2	10	2
	Superior, 4004	8	3	6	1
	Superba, 2984	4	6	1	0
	Hopewell, 3073	9	4	6	2
	Chesterfield, 4055	1	0	0	0
	Crystal, 3799	2	4	3	0
	De Joy, 2765	1	3	3	0
	Devonshire, 3645	9	1	6	3
	Diamond, 2914	4	0	7	1
Sounding	Dobson, 3386	5	0	6	1
Creek	Earl Grey, 2308	4	1	2	1
M.D.	Helen, 4199	2	0	4	0
No. 273	Little Gem, 2551	2	3	1	1
	Marby, 3419	9	2	10	0
	Marguerite, 2568	2	0	0	0
	New Bliss, 2351	3	4	3	0
	Ryerson, 3113	0	2	0	0
	Wostina, 2675	5	2	1	1

TABLE V—Continued

Municipal Unit	Name and No. School District	No. Families	No. Bachelors	No. Child. Grades 1-8	No. Child. Grades 9-12
	Mericourt, 3963	6	3	4	0
	Flaxland, 2988	5	1	0	0
	North Hampton, 3332	5	0	2	0
	Evadne, 3100	1	0	0	0
	Chilmark, 3102	0	3	0	0
	Wheatsheaf, 2426	12	2	10	5
	Thackeray, 3501	3	5	0	0
	Langford, 3301	7	2	3	1
S.D.'s in Local Improvement Areas	Green Mound, 2734	15	13	20	4
	Cappon, 2811	14	8	21	3
	Lovedale, 3671	7	4	8	2
	Viewland, 3139	6	1	6	1
	South View, 3487	9	3	8	4
	Emslie, 4047	14	3	14	4
	Dry Lake, 3075	13	1	26	3
	Crocusdale, 2857	15	1	10	4
	Hillmartin, 4168	6	4	3	2
	Arethusa, 4449	7	5	9	1
	Lewis, 3517	8	5	8	3

Table V shows the school situation which exists in the Oyen Inspectorate which is in charge of Inspector Scott, as at October 1935. The table shows the extent to which municipal and school organization had proceeded in this area during the optimistic boom period and it also graphically illustrates the difficulties which are encountered to-day in trying to provide adequate school facilities for children living in the area. The difficulty of maintaining the primary contacts necessary to a normal community life under conditions of such sparse population as have been described, are rather obvious, but the still greater difficulty of supplying adequate social services such as schools, roads, medical and hospital aid for the people is one that is well nigh insuperable because of the cost. The Tilley East area provides an excellent picture of what happens when an unsuitable district is settled with the object of farming. Prior to 1908, the pioneer rancher had dominated this area since the early 90's. He had been moderately successful and had experienced little difficulty until the exceptionally hard winter of 1906-07 when some losses were recorded. With the big influx of settlement of 1910 and 1911, homesteaders covered the area to such an extent that, at the peak of settlement, 2,400 resident farmers occupied the seven Municipal units consisting of L.I.D. Nos. 122, 152, 182 and 211 and M.D. Nos. 123, 153, 183. Big crops were harvested in 1915, 1916, 1927 and 1928, while in the intervening years crops were light and, in many instances, were not worth harvesting. In the meantime, Municipal organization had taken place, school districts were set up and roads built. By 1926, there was an accumulated public debt against the land in this area of $1,746,195.00, made up mainly of uncollected taxes, unpaid seed grain and relief liens. In addition to the public debt, private debts in the form of mortgages, implement charges, etc., amounted to $4.00 an acre in the same period. MacIntosh (18), in his book, "Economic Problems of the Prairie Provinces," summarizes the situation by saying: "The result of an unsatisfactory settlement policy in the Tilley East Area may be recapitulated very briefly. Its lesson is obvious. Some 2,400 farmers were permitted to settle an unsuitable district. Fifteen years after farming had become general, 500 remained in the area. Public and private costs estimated at four million dollars had been incurred, or nearly eight thousand dollars for each remaining resident farmer. The greater part of these costs cannot be recovered. This unfortunate experience may be attributed in part to the fact that when this district was settled, the Dominion controlled the alienation of land, while the Province was forced to assume a large proportion of the financial cost of necessary relief."

The history of settlement in the Tilley East Area is pretty much the history of settlement in the major portion of the dry area. That experience has proven conclusively that if the area is going to continue to support a farming population, it must be on the basis of some different system of land tenure and a different basis of social organization. In the first place, the land must be re-valued so that the operator's investment in the land bears a reasonable relationship to its productive value, either on a rental or purchase basis. In the second place, the resulting larger farm unit will result in a necessary re-organization of communities involving a consolidation of existing schools and municipal units and a re-grouping of

settlement in such a way that most effective use can be made of school, medical and distributive services. The first attempt to initiate this re-organization of settlement policy was the enactment of The Tilley East Area Act (37), which provided for a joint Dominion-Provincial Board to administer the area. The Board commenced operations in 1929 and laid down the premise that the area could only maintain a comparatively small population. Acting on this premise, settlers desiring to leave the area were assisted in moving to more favoured areas by the provision of free freight to their new location. At the same time that settlers were being moved, provisions were enacted prohibiting other settlers from coming in. Arrangements were made with the Canadian Pacific Railway, the Hudson's Bay Company and mortgage companies for long-term leases of vacant lands so as to permit an exchange of lands with a view to consolidating holdings of private companies in blocks. The exchange policy also made it possible for the settlers on the more unsuitable land to exchange their holdings for better ones, thus the tendency has been to concentrate what settlement remains on the better soils within the area. This re-organization permitted the consolidation of numerous school districts, the closing of roads and a general reduction in the overhead costs of administering the area. Provision was also contained within the Act for the extension and conservation of water resources, the consolidation and extension of private grazing leases and the establishment of community leases; the whole plan being designed to enable the population to be self-supporting. The joint Provincial and Dominion Board was abolished in 1931 and the Area put in charge of an Administrator under the Department of Municipal Affairs. In 1932, the idea was extended to include the Berry Creek Area and in 1934, the Tilley East and Berry Creek Areas were replaced by The Special Areas Act (36), which, in effect, is a land utilization Act under which power was given to the Lieutenant Governor in Council to appoint a Board which would be charged with the responsibility of administering these Special Areas and adding to or extracting such other areas as were thought necessary from time to time. The Special Areas Act makes it possible to completely re-organize the whole of the dry area and put it on a basis where the population can enjoy a reasonable standard of living on a permanent basis. The next task is to work out a detailed plan of community organization and farm management which will permit the most efficient utilization of the resources of the area in the interests of the settlers and the Province. This will be discussed in the succeeding sections.

A Plan of Settlement for the Dry Area

Any plan of settlement for the dry areas should be adopted only after the most careful consideration of all the factors involved. The plan should make use of all scientific knowledge that is related to the problem, all records of the past 30 years, coupled with the experiences of successful settlers residing within the area. The problem should be attacked with the object of arriving at the maximum population that the area will contain and provide with a decent standard of living. The point should never be lost sight of that settlers may be just as much or more of a relief problem in certain areas of wooded soils as they are in the dry area, and that when the dry area is viewed as an alternative to making a home in the wooded areas, the advantages do not all lie with the latter. To begin with, the soil of the dry area is in the main, extremely productive when rainfall is abundant, it is easily worked and operating costs are low; the winter climate is quite favourable and the cost per mile of constructing roads is much less than in the north. In the light of these factors, it would seem that a reasonable plan of settlement which would utilize to the full the resources of the dry area can be worked out.

The first requisite and in fact the basis of any permanent settlement should be a careful and systematic classification of the soil. This has been done in those portions of the area known as the Medicine Hat, Sounding Creek and Macleod Sheets, thus the greater part of the area has been classified. On the basis of this classification, the various types of soil can be put to the use for which they are best adapted, whether that is wheat growing or ranching or a combination of both. In Table IV., the land which has been classified is divided according to whether it can be used for ranching or grazing on the basis of figures given by Wyatt (32), in the provincial soil survey bulletins. In this table, land that has been classified as fine sand, fine sandy loam, loam (hilly phase), silt loam (blowout phase), river bottoms, eroded land and lake land has been graded as ranch land, and all land classified as loam, loam (rolling phase), silt loam, silt loam (rolling phase), clay loam and clay, as grain growing land. On the basis of this classification, 3,208,194 acres are classed as ranch land and 4,433,778 acres as grain growing land. Having classified the land within the Special Areas in such a way as to permit its most effective utilization, the next problem is that of organizing settlement in such a manner as to permit the greatest degree of social progress and human happiness at the minimum cost.

TABLE VI—Land in Medicine Hat, Sounding Creek, and Macleod Sheets. (Classified as to General Suitability for Ranching and Grain Growing.)

	Ranching including fine sand, fine sandy loam, hilly phase loam, silt loam (blowout phase), river bottom, eroded land and lakes.									Grain Growing including loam, loam (rolling phase), silt loam, silt loam (rolling phase), clay loam and clay.						
Sheet	% F.S.	% F.S.L.	% L.	% L. h.p.	% S.L. b.p.	% Mix. Areas	% Riv. Bottom	% Eroded	Total	% L.	% L. r.p.	% S.L.	% S.L. r.p.	% C.L.	% C.	% Tot. Area
Medicine Hat	9.3	7.4	.1	13.0	4.9	3.4	.43	7.8	46.25	22.1	10.6	13.18	4.92	.37	2.1	53.27
Sounding Creek	2.3	8.3	....	....	23.1	1.8	....	4.3	39.8	44.6	....	8.8	....	3.0	1.8	58.2
Macleod	9.5	12.0	....	2.1	....	1.3	2.8	8.1	35.7	26.0	....	23.0	....	13.3	1.6	63.9
	21.1	27.7	.1	15.1	28.0	6.5	3.23	20.2	121.73	92.7	10.6	44.98	4.92	16.67	5.5	175.38

Ranching, 3,208,194 acres.

Grain growing, 4,433,778 acres.

There is a possibility that this end might be gradually achieved by making possible through a suitable system of land tenure, the acquiring of home sites in community centres so that the fullest use be made of already established transportation, water, education and distribution facilities. In other words, certain facilities are in existence in the dry areas, the possibility of their extension is very remote; it then would appear to be more economical and satisfactory if the people residing in such areas would move to the services rather than have them brought to them. In fact, it is altogether likely if this is not done the people will have to do without services that might otherwise be made available.

Each home would require a sufficient tract of land to provide for garden and pasture for the minimum number of live stock necessary to provide for household needs. The original farm or ranch unit would continue to be operated from the community centre. If such an ideal settlement plan could be developed, the social life would be normal, the cost of distribution services lower and the community would have a better bargaining power, particularly if the co-operative system were followed.

The success of such a plan of community settlement depends upon the embodiment in the community organization of safeguards for individual rights and privileges, and at the same time to permit the natural development of co-operative or community enterprise, but its continuance or success must not be dependent upon community organization. Its advantages must justify its continuance. The success of such a plan is greatly enhanced where modern motorized farm equipment is used. In fact, under horse economy it would be difficult, if not impossible, to work out. In areas where large units are cultivated, motorized power appears to be quite definitely more economical than horse power and will in all probability continue to be so with the development and adaption of the Diesel engine. All the equipment in the way of buildings needed on this farm would be a few granaries, and a tool house or machine shed where implements could be stored and repairs made. Sufficient grain and forage could be grown on this farm to supplement that grown on the homesite. It enables the residents to partake of all of the benefits of a thickly settled community, while at the same time preserving the freedom of farm life. It is not a small town community, yet from the educational and recreational viewpoint, it can have all of the advantages of a good school, medical aid, church organization and well organized distributive facilities.

From the viewpoint of providing Government services, it would make possible the maintenance of rural telephones, school, health and other services at greatly reduced cost. The objections that are likely to be made to such a plan are that people will prefer to remain on the farm; that the cost of re-locating will be too costly; that the farmer would have to travel too great a distance to work his farm, and that such community projects have been tried and failed. The only answers to these objections are that if the advantages of this community plan do not outweigh the disadvantages of the present mode of residence, it should not be undertaken or encouraged. Actually, these objections may or may not be serious. For example, if we consider the matter of travel, if a farmer is forced to travel 20 miles per day to and from work, he will not likely have to do so for more than 200 days per season. Thus, he would travel 4,000 miles per year, which at a cost of 5 cents per mile (actual recorded costs), would be $200.00. In other words, the additional cost of permitting his family to enjoy good school and other facilities by living in a community centre is approximately $200.00 per year. Such additional costs as this might be more than offset by the use of community water supply instead of individual wells and by the saving in operating schools, building roads and telephone lines.

THE COST OF PRODUCING WHEAT WITH HORSE VERSUS MECHANICAL POWER

In any discussion of costs of production, it will be found that we have to deal with a certain number of cost-determining factors, each of which exerts a very direct influence on the net income the farmer receives. The basic factor of all in wheat production is land, because upon the suitability of the soil and climate to the growing of wheat will depend whether the crop can be grown economically or not. The man whose farm is level, free from stones and broken land, has an advantage over the man situated in the same district whose land is hilly, stony and cut up with ravines or other obstructions. The question of yield per acre is more important in its effect on the gross income than it is on the cost of production, as

it requires almost as much labour to produce a 20-bushel crop as it does a 30-bushel crop. After the lands natural capacity is reached with ordinary tillage methods, it may require more labour to increase the yield, that is, a more intensive than extensive type of farming, and if by farming more intensively the yield can be increased sufficiently to offset the added cost of labour, it is worth while doing so. Yield per acre is very closely associated with the return per unit of labour expended and, to the extent that a greater return in bushels can be obtained per unit of land or per unit of labour, it is an important factor in reducing production costs.

The class or type of soil on a farm may exert a very definite influence on production costs, even if the crop producing power is the same. For example, on one type of soil a farmer may be able to pull a four-bottom plow, with a tractor of a given power, while on another type of soil it will only pull three-bottom plows, thereby showing an increase in tillage costs. Another example where variation in soil type exerts a definite influence on the cost of operations is on the gumbo soils where wet weather may prevent the doing of necessary work in its proper season, with a consequent increased cost of operation and deterioration in the quality of work done. Proximity to shipping point and the type of market are other important cost-affecting factors.

Prevailing rates for hauling by truck are from ⅜ to ½ a cent per bushel per mile, hence length of haul is a very important cost factor. The type of market road is also important, affecting as it does the size of load hauled, the speed at which it is hauled and the wear and tear on equipment. Next in order might be discussed the arrangement of the cropping system and the size of farm. This involves a consideration of crop rotations, strip farming and subsidiary enterprises. Does the arrangement of fields permit the most economical use of labour and machines, and are the machines of the type that are most economical to use. Last but not least in importance, is the farm operator himself. Some men bring a natural business capacity to their work, they are better managers than their neighbours, and quite frequently one man can be seen making a success of his farm enterprise, while his neighbour across the fence is steadily going behind. These factors and many others not here discussed, are primary cost affecting factors.

Of the separate costs to be considered, that of land rental is usually the most important, because it is basic and inescapable. It is usually this cost which determines whether it is economical to grow wheat or not. Land rental in the economic sense is the annual capitalized value of the land plus taxes, and this constitutes a first charge against whatever may be grown on the land. For example, if wheat is grown on land which cost $30.00 per acre, and the taxes on that land are $80.00 per quarter, the land rental would be $30.00 per acre, capitalized at 5 or 6%, plus 50 cents per acre for taxes, or a total of $2.00 per acre, as a first charge against the wheat produced. Similarly, if land was worth $60.00 per acre and the taxes $100.00 per quarter, the land rental charge would be $3.62 per acre, and so on. The values and taxes quoted here are values that are typical of certain sections of Alberta where wheat is the major enterprise. On the other hand, the land rental charge in the south-eastern portion of the Province, where land values are as low as $7.50 per acre and taxes $20.00 per quarter, is 50 cents per acre, or approximately 15% of what it is in the Edmonton district. While it is true that there is often a great difference in the yield per acre between the north and south, the yields are not by any means in proportion to the increased land rental charge. This should make it clear that where land is high priced, it is very difficult, if not impossible, to produce cheap wheat.

Tillage Costs

In discussing tillage costs, the cost of breaking new land will not be included because it is usually included in the original investment, particularly when the farmer buys improved land. As a matter of information, however, the cost of breaking new land varies from as low as $4.00 per acre, on the prairie, to $15.00 and $25.00 in the heavily wooded sections. One instance is recorded where the actual cost in cash of breaking 300 acres of prairie sod in 1932 was $1.69 per acre, when ordinary tractors were used on a farm at Nemiscam. In the following table, setting forth the costs of all tillage operations carried out with horse equipment at the Scott Experimental Station in 1930, will be found a set of cost figures that fit fairly accurately to a typical brown soil farm.

TABLE VII—Amount of Work Done per 10-Hour Day and Cost per Acre (Scott Station, 1930, Using Horse Equipment.)

Implement	Size	No. Horses	No. Acres	Cost per Acre	
				1929	1930
Plowing Sod	2-14″ plow	5	3.96	$1.77	$1.39
Plowing Stubble	2-14″ plow	5	4.81	1.46	1.14
Discing	8′	6	14.0	.56	.44
Harrowing	24′	6	52.0	.15	.12
Cultivating	9′	6	14.0	.56	.44
Packing	15′	6	29.0	.27	.21
Seeding	10′	4	20.6	.30	.24
Cutting Grain	8′	4	15.0	.48	.39
Stooking	....	....	....	.40	.20

Horse labour figured at 6 cents per hour.
Man labour figured at 25 cents per hour.
Depreciation, $1.35 per acre.

From the data shown in the above table, it will be seen that the outfits used were typical horse outfits as used on prairie wheat farms, and the number of acres covered per day with each machine are the average acreages covered with those implements over a period of years. Under large farm conditions, it is possible that slightly larger acreages per day would be covered and thus the cost per acre would be reduced slightly, but in general the figures are representative.

Table VIII shows these costs applied to the production of a crop in a typical brown soil belt farm.

TABLE VIII—Showing Cost per Acre of Producing Wheat in a 3-Year Rotation with Standard Horse Equipment

Operation	Cost per Acre	COST PER ACRE		
		Fallow	Wheat after Fallow	Wheat after Wheat
Plowing stubble	$1.14	$1.14	....	$1.14
Packing	.21	.21	....	.21
Harrowing	.12	.12	....	.12
Cultivation	.44	1.32	....	....
Seeding	.24	....	.24	.24
Harrowing	.12	....	.12	.12
Cutting	.39	....	.39	.39
Twine	.15 lb.	....	.37½ (2½ lbs.)	.30 (2 lbs.)
Stooking	.40	....	.40	.30
Threshing	.10	....	2.00	1.50
Depreciation	1.35	.65	.70	1.35
Land rental	2.00	2.00	2.00	2.00
Share of fallow cost	....	....	3.63	1.81
TOTAL COST	....	$5.44	$9.85	$9.50

The above table shows the cost data of Table VII. adapted to the two most common wheat growing rotations found in the dry area and using 1930 costs. It shows that the cost of summer fallowing is $5.44 per acre, while $9.85 per acre is the cost for the first crop after fallow and $9.50 per acre for the second crop if one is taken. The costs at the Whitla Illustration Station from 1925 to 1929, as given by Moynan (23), were: summer-fallow, $5.74 per acre; first crop after fallow, $12.07. No charge has been made for seed grain, but this charge has been accounted for by subtracting one bushel from the yield per acre each year. In this way the variations in cost of seed are not shown in the operating cost.

Power Farming Costs

In dealing with power farming costs, it will be found that there is a very close inverse relationship between the number of hours a tractor is used and the costs per hour. Hopkins (13), in a survey conducted in Iowa found that invariably where the amount of usage was under 300 hours per season, the costs were over $1.00 per hour. On farms where the tractor was used between 300 and 400 hours, the cost was about 80 cents per hour. Allen (2), in his cost studies in Saskatchewan, found that the average amount of field work done with tractors was 38.5 days per season or approximately 400 hours. However, as fuel costs are higher in Canada than in the United States, the cost per hour works out at approximately the same as 300 hours in the United States, namely, $1.00 per hour. To this cost, is added wages for an operator at 25 cents per hour and depreciation at $1.35 per acre, a charge which long experience has shown to be necessary to take care of replacements of machinery. These costs are summarized in Table IX.

TABLE IX—Amount of Work Done per Day, and Cost per Acre, 3 Years Rotation with Power Equipment

Operation	Size of Outfit	Acreage Per Day	Cost Per Acre	Cost per Acre		
				Fallow	Wheat	Wheat
Plowing	3-14″	14.4	$ .86	$ .86	..	$ .86
Double Discing	21′ s.d.	37.1	.36	...	....	...
Cultivating	12′	35	.41	1.20	....	
Harrowing	24′	100	.12	.12	$ .24	.24
Seeding	28 run d.d.	50	.25	....	.25	.25
Packing	16′	60	.21	...	.21	.21
Cutting	10′	37	.36	....	.36	.36
Twine	2½ lbs.	....	.37	....	.37	.30
Stooking	...	....	.40	.	.40	.30
Threshing	10c bus.	....	....	....	2.00	1.50
Depreciation	....	....	1.35	.70	.65	1.35
Land rental	....	....	2.00	2.00	2.00	2.00
Share fallow cost	....	....	....	..	3.26	1.62
TOTAL COST	....	....	....	$4.88	$9.74	$8.99

In Table IX., wages for the operator of the tractor were charged at $2.50 per day (this included wages and board) and two-thirds of the cost of summer-fallowing was charged to the first crop after fallow and one-third to the second. If only one crop was taken, the cost per acre would be increased by $1.62, bringing it up to $11.36 per acre. The fact that wages are lower today than when these figures were compiled (1931-32) would mean that there would be a slight reduction in total costs. However, as the labour charge for horse and power operations is the same, the comparison of the two sets of costs, as shown in Table X., is not affected.

TABLE X—Comparison of Acre Costs of Horse and Tractor Farming under Brown Soil Conditions, Using Standard Equipment

Method	Cost of Fallow Per Acre	Cost of Wheat Per Acre	Cost Wheat 2nd Crop	Total	Average for Rotation
Horse Equipment	$5.44	$9.85	$9.50	$24.79	$8.26
Power Equipment	4.88	9.74	8.99	23.61	7.87

Where only one crop is taken after fallow, the cost per acre of the wheat crop would be $11.66 and $11.36 for horse and power costs, respectively. The figures quoted in the foregoing table show that when ordinary equipment is used, power costs are slightly lower than horse costs. However, when newer large scale types of machinery are used, power costs are greatly reduced and the figures quoted in Table XI. are the actual costs of farmers operating different outfits in the dry area.

TABLE XI—Cost of Producing Wheat with New Power Equipment

Operation	Size of Outfit	Acres per Day	Cost per Acre	One-way Drill Harrow	Plow Drill Packer	Cultiv. Drill Harrow	Fuel Costs
Plow-drill	3-18″ plow 56″ packer 9-6″ drill	18.3	$1.19	....	$1.19	....	24½c gal.
Cultivator-harrow drill	9′ duckfoot 15-17″ drill 10′ harrow	26.2	.75	....		.75	14½c gal.
One-way drill	8′	24.1	.65	$ .65	....		14½c gal.
Combining	16′	38	1.03	1.03	1.03	1.03	
Land rental		....	2.00	2.00	2.00	2.00	
TOTAL		....	....	$3.68	$4.22	$3.78	

The foregoing costs are those for putting in and taking off a crop on stubble and no allowance is made for the cost of summer-fallowing. When these costs are added, the total costs are $5.68, $6.91 and $5.78, respectively, for the one-way, plow-drill, and cultivator packer combinations. When it is considered that these costs include a fixed charge of $2.00 per acre for land rental, they are remarkably low, yet they are the actual figures of efficient farmers. Horse costs with large power units, have not been obtained, but keeping in mind the fact that pasture and forage are comparatively costly to produce in the dry area, a statement of horse requirements in the way of grain, forage and pasture, will show that, in order to produce sufficient feed to provide horsepower, a very substantial portion of the farm is taken out of wheat production. The minimum number of horses required to operate the machinery described in Table XI., would be ten and this would mean that at least 12 horses per farm would be required, thinking always in terms of the one-man operator. Pasture requirements for horses for one year in the dry area, are put by various authorities at from 30 to 50 acres per head. This would require 360 acres or over half a section of land, which is out of the question. The next basis is to feed the horses all the year round and only use sufficient pasture to provide a paddock for them when they are idle. For the seven months of the working season, two tons of roughage, consisting of oat hay or straw or rye would be needed. For the five winter months, two tons more per head of straw would be required during the working season. On the basis of an average production of half a ton of forage per acre, it would require eight acres to produce sufficient forage for each horse or 96 acres for the farm unit of 12. An oat yield of 20 bushels per acre, would necessitate four acres per horse or 48 acres for the farm unit of 12. In addition to this, a pasture of at least 50 acres would be required for the horses to run in during idle time in the summer, thus the total acreage required to feed the horse unit, would be 194. In other words, if a man was operating 1200 acres, approximately one-sixth of his land would be required to provide feed for his power unit instead of growing wheat. Two hundred acres of wheat at 10 bushels per acre and 50 cents per bushel would mean a revenue of $1,000.00, which would buy a lot of fuel oil and repairs for a tractor. Another thing that must not be lost sight of in considering the power farming situation, is the almost inevitable increase in the use of the Diesel tractor in view of the fact that Diesel operating costs at the present time are approximately one third of those of ordinary tractors. From the foregoing evidence, it seems amply clear that mechanized power should be used under dry farming conditions from a purely economical consideration. When considered in relationship to the sociological factors involved, the argument is doubly strong. In concluding this phase of the discussion on community settlement, it might be well to recall the experience of the U.S. Federal Emergency Relief Administration, as stated by Westbrook (31), in "The Annals" of November, 1934. Speaking of organized rural community settlement in relief areas, Westbrook has the following to say: "The establishment of organized rural communities where those conditions prevail, has been demonstrated by the Federal Emergency Relief Administration as a practical and economical procedure. By using work relief in the construction of these communities,

nearly half of their cost can be absorbed from funds which would have been expended anyway in extending relief to the workmen engaged in building operations. Thus the cost of the physical plant, that is, the land, houses, and other facilities, will be materially lessened. The cost of relief and rehabilitation after the plant is built will depend upon the extent to which the families are able to take care of themselves." The plan being followed in the United States, in this instance, is dealing with slightly different conditions to those of our drought areas, but they recognize it as important and insist upon the organization of the scheme on a community basis rather than any other.

A Live Stock Policy for the Dry Area

In thinking of a live stock policy for the dry area, it is the farmer who is in mind rather than the rancher. The rancher, through long experience and sound management practice, has been able to work out a production programme that has been reasonably efficient. The dry farmer on the other hand, has not followed a consistent policy either in regard to the type of live stock raised or the management policy. The result has been waste, inefficiency and expensive feed relief. The first thing to consider in a live stock policy, is the object of having live stock. In the case of cattle, it is for the production of milk and beef. This can be obtained by having both dairy cows and beef cows, but under dry farming conditions, where numbers are of necessity limited, the dual purpose Shorthorn, capable of supplying both milk and beef would seem to be the reasonable choice. Stock of only the best quality should be kept because of their greater efficiency in the use of feed. The numbers should be limited for each farmer and should vary between two and four head of breeding stock. The policy should be followed of not carrying young stock over the winter except in years when feed supplies are abundant. In this way, the problem of winter feed would be a relatively stable one from year to year and, in case of shortage, the exact requirements would be readily known in advance. The guiding principle as to numbers of live stock in the dry farming areas should always be the minimum number required to adequately supply family needs. With this in mind and the community settlement policy in effect, the question of obtaining suitable sires would be quite simple. Advantages could be taken of the Government's Bull Loaning Policy, with the result that one or two bulls might serve a whole community and the expense involved would be almost negligible, whereas under the scattered settlement policy it was often very expensive and impractical to take advantage of such a policy and the result has been that scrubby, off-type bulls were being used in the majority of cases. Another point that the dry farmer must not lose sight of in respect to his live stock policy, is that unless he is situated very close to an urban centre, there will be no market for fluid milk, so that he is not only limited by conditions of feed scarcity to restricting his herd, but also because of the lack of a market for excess milk. On the other hand, if any farmer wishes to increase his herd beyond the numbers regarded as necessary and practical, he should not be entitled to feed relief at the Government's expense in time of distress. Before receiving relief, he should be compelled to liquidate his herd to the point where only sufficient were retained for family needs.

In the case of swine, the policy should be followed of having sufficient numbers of good bacon type to supply family needs. One sow per family would ensure this and the cost of maintenance would be very small because of the pig's ability to use garbage and other material that would otherwise be wasted. The same breeding policy would be followed as in the case of cattle. Community sires could be used. Young pigs could either be marketed at weaning time or kept till fall and fattened if grain supplies were adequate. There is really no valid objection to raising pigs in the dry area as long as the farmer has adequate feed and water supplies. Wheat can be fed to pigs quite profitably. Six-cent hogs are equivalent to 60-cent wheat and if wheat prices are below 60 cents and hog prices are six cents or better, this is a profitable way of marketing the wheat. If the price relationship changes rapidly it is always possible to get out of the hog business quickly, a point that may be worth considering from the individual farmer's standpoint, but which is not a good thing for the bacon industry and, for that reason, should not be encouraged. As a general policy, the main emphasis on hog raising under a dry wheat-farming programme should be on supplying family needs rather than as a secondary farm enterprise.

Sheep are in very much the same category as hogs in a wheat farming programme. From two to four breeding ewes per family could be kept and they should be preferably of the Oxford or Hampshire breeds. This community breeding policy would apply here as well, as with cattle and swine. In the case of a com-

munity having sheep, a greater degree of co-operation is called for than with any other type of live stock. Sheep pastures have to be fenced. Otherwise the sheep are a continual source of annoyance to neighbours. If every farmer in a community centre of 40 operators, had to fence for his three or four head of sheep, the cost would almost be more than the sheep were worth. On the other hand, if the sheep were run on a community grazing lease, the cost of fencing would be relatively low. A further possibility would be for the community to form some sort of co-operative association and run a flock of sheep in charge of a herder in a range district somewhere near the community centre. In this way, larger numbers could be handled and profitable use might be made by the community of land that was not suited to any other purpose.

Poultry are a necessity on every farm and provision should be made for a flock of from 50 to 100 hens and a few turkeys on each farm. Only the best quality birds should be kept and for the average farmer the utility breeds such as Wyandottes and Plymouth Rocks would undoubtedly be most economical. For the individual who has a flair for poultry raising, it might be possible to establish quite a profitable secondary enterprise by having a large flock of one of the laying breeds.

The guiding principles of the wheat farmer in the dry area as far as live stock is concerned should be, first, the maintenance of only sufficient livestock to supply the family needs and second, the efficiency of that stock in the utilization of feed. A cow that gives 3,000 pounds of milk per year will consume just as much feed as the cow that gives 6,000 pounds and the same principle holds good for all other types of live stock. The dry farmer of all farmers is the one who can least afford to have inferior live stock.

In this discussion of a live stock policy, nothing has been said of the position of the rancher for the reason that where the rancher has been able to work out his own salvation, he has not been a problem. The south-eastern portion of the Province of Alberta, is the centre of the ranching and beef industry, and while the rancher has been having a difficult time during the last few years, his problem has been one of marketing rather than production. That being so, if the whole of the dry area is classified according to the use to which it is best fitted, the rancher will be able to extend his territory and his methods of management, with the result that the problem area will be reduced accordingly. While a great deal of unsuitable land is being taken out of wheat production, the wheat farmers will be concentrated in areas where by proper application of scientific principles and sound management practices, they will be able to make a success of their farming operations.

Production and Conservation of Feed and Water Supplies

It was pointed out in a previous section, that it requires from 35 to 50 acres per head of live stock to provide pasture the year round. Obviously then, the dry wheat farmer who cannot afford to set aside the necessary land for pasture, must be prepared to feed his stock the year round. Under the proposed community settlement plan, it will be recalled that each homesite was to consist of a small acreage, some of which would be used as a paddock and the rest for growing a small supply of feed which would be supplemented by more grown on the main farm. Daytime pasture in the summer months was to be taken care of by the community pasture and the pasture was to be supplemented by a daily ration of home-grown feed. Obviously then, the next question to consider is what are the types of feed most suitable and what amounts are required per head to provide one year's supply. It must always be remembered that the farmer is governed in what he shall feed, not by what he would like to feed or what he knows is best, but by what he can grow. Experience has shown, however, that he has a fair range of choice with the chief feeds at his disposal being oat hay, wheat hay, rye hay, prairie hay, slough hay, sweet clover, alfalfa and corn. Oat hay cut in the dough stage is the best and wheat hay cut in the early dough stage next. According to Thompson (30), spring rye has been proven to be better than other forages grown in the dry area for wintering beef cows, while fall rye cut in the early dough stage, has been almost equal to alfalfa. All of the feeds mentioned can be used successfully and where alfalfa and sweet clover are used, they should be supplemented with straw and not fed alone. Thompson also states that, although crested wheat grass has not been used extensively up to the present time, it is equal in feeding value to either prairie hay or blue joint for feeding beef cattle. Slough grass consisting mainly of sedges will maintain cattle successfully if cut and stacked before the seeds are set. Otherwise, it has about the same feeding value as straw.

Having decided upon the feed to grow, the method of cultivation is next to be considered. Ordinarily, grasses can be sown just as any other crop but, under dry conditions, extreme care must be taken with the preparation of the soil and time of planting. Grasses should be sown without a nurse crop on summer-fallow, about the middle of June. Cattle or sheep should not be allowed to pasture on them the first year. The most drought-hardy forage of all is alfalfa, but extreme care must be exercised in getting it established. It should be sown on clean, well-packed summer-fallow without nurse crop and, under no circumstances, pastured the first year. Unless the season is favourable from a moisture standpoint, half the drill openings should be closed, thus the rows are twice as far apart as normally. In this way, the plant roots are able to get the moisture from twice the area. The same practice may be followed in seeding oat hay, and other spring grains and it is believed that, if this system is followed, it will be possible to raise a certain amount of feed even in the driest years. If necessary, two-thirds or three-quarters of the drill openings could be closed in order that the grain would be handled as a row crop. While there is very little data to substantiate it, some farmers in the dry area make the claim that it is possible to grow more feed in an extremely dry year this way than by any other method. The objection raised against it is that it is a costly method in time during both seed time and harvest, but if it is possible to grow feed by this method when others fail, it should be followed. Another objection is that Russian thistles would occupy the spares between the rows and grow to such a size that the crop would be extremely difficult to harvest. This undoubtedly is a danger, but it might be overcome by inter-tillage where the acreage sown was not too large. The point is that, when live stock numbers are low, it is possible by special methods to grow sufficient feed for them even in the driest years. Under the recent Dominion-Provincial dry area reclamation projects experiments are being carried out with some success whereby created wheat grass is being sown right in among the weeds and Russian thistles on land that has been previously cultivated and abandoned. In some cases, excellent catches of grass have been established and if the experiment proves successful on a large scale, it will greatly increase the carrying capacity of much of the poorer sections of the dry area.

Emergency Feeds

Under the heading of emergency feeds, straw and Russian thistle might be considered, although straw is often considered as a normal feed. To begin with, oat, wheat and barley straw can all be used; oat straw of course being preferable. As a rule, all three are low in feeding value, being low in protein and minerals. Straw has a tendency to be constipating, particularly for horses, but may well supply a portion of the roughage requirements for horses, cattle and sheep as long as plenty of water and salt are available. The second and most common emergency feed in the dry area is the Russian thistle, and when used with care and judgment, it can be very valuable indeed. When fed alone, Russian thistles have a very laxative and weakening effect and loss in weight will be bound to result. However, if cut green before the spines have developed and stacked right away, these thistles have a feed value that is said to be only slightly lower than that of sweet clover. If the majority of the ration consists of Russian thistles or poor straw, an attempt should be made to secure some green hay as a supplement and, in addition, about a pound of linseed meal per day should be added. Sprinkling the thistles with water 10 to 12 hours before feeding, softens the spines and makes the hay more palatable. Grinding in a hammermill also makes it more acceptable.

Feeding Requirements

In feeding cattle, it should always be remembered that the provision of some form of shelter will save feed and this should be provided. When calves are fed in a shelter without the opportunity of grazing, they require from eight to ten pounds of hay per day in the ordinary winter. This amount is sufficient to maintain them in weight and in a thrifty condition. They will eat more than this if allowed but maintenance is all that is required. According to Thompson (30), yearlings require 12 to 14 pounds of hay per day for a maintenance ration during the winter and cows require from 15 to 18 pounds per day, or approximately one ton of hay for a period of 110 to 120 days of winter feeding. For milk cows in milk it requires ½ a ton of good straw or ¼ ton of hay and 175 pounds of grain per month per cow. On the basis of full winter feeding for cows in milk with an allowance for some pasture supplemented by feed in the summer, it would require a minimum of two tons of good green forage and half a ton of straw per year per cow. To this, it would be necessary to add approximately 300 pounds of grain for each cow. Taking one-half ton per acre as the minimum production of forage and 20 bushels per acre of oats, it would require 4½ acres of cultivated crops per

head of stock. It seems reasonable to suppose that this much feed could be produced in most years.

Horses require two tons of good quality roughage and two tons of straw and 80 bushels of oats to carry them through the year so as to be in good working condition for the summer months. Sheep on the other hand require about one-quarter of the amount of grain and roughage fed to cows. Only such stock as can be brought through the winter in good shape should be kept. Five cows or ewes or pigs that are brought through the winter in such shape as to produce a normal increase are likely to be much more profitable and less expensive than double the number starved through.

METHODS OF STORING SURPLUS FEED

Much of the ranchers freedom from the necessity of feed relief is due to his foresight in always carrying over a surplus of feed from year to year so that by the time and exceptionally dry year comes along he can use his reserves. What has been common practice in the ranching areas for years should be insisted upon as being a good practice for any man who has live stock, no matter where located. The practice of burning straw stacks on the prairies is one that should be stopped at least until such time as the farmer who is doing the burning has at least two crops of straw ahead. Even dry wheat straw looks very good when the ground is covered with snow and there is nothing else. Very little extra care is needed after the harvest season is over to put a good top on a straw pile and if this is done, the straw will keep for years. Stacks of oat hay or any of the other hay crops should be carefully covered with at least three feet of straw each spring after the feeding season is over. These straw caps should be fastened down with ropes made of hay, wire, or by a network of poles. Stacks of sheaf grain should be re-topped either with a thatch or by careful re-arrangement of the sheaves so that they will turn water. When these precautions are taken, feed can be carried over from year to year without difficulty. Grain is not difficult to carry over if the farmer has sufficient granary room and if he can be persuaded not to sell it. The policy of carrying over sufficient grain from one season to the next, to provide an extra year's supply, should be encouraged. If this was done, the problem of feed relief would be greatly reduced. It is almost impossible to legislate people into carrying reserves of this kind if they will not do it of their own accord, but legislation could be enacted which would make it possible to hold what feed supplies there were within a given area. For example, it is possible for a government to pass legislation which would enable it, on a given date, to proclaim any certain area as a drought area. This would only be done where it was evident that a serious feed shortage was imminent. With the proclamation issued as going into effect on a given date it would mean that no farmer, dealer or agent would be able to sell feed (either forage or grain) without a permit to do so. In this way, it would be possible to mobilize the entire feed supply of a given area and possibly avoid the expense and inconvenience of shipping feed out of one district and then shipping it back again to an adjoining district at greatly increased cost.

WATER RESOURCES AND METHODS OF CONSERVATION

It was pointed out in an earlier section that the water resources of the dry area are very limited. The number of natural lakes and streams is such that over the greater portion of the area, settlers are dependent either on drilled wells or dams. The water supply, in many sections of the area, is the limiting factor and, if this obstacle was overcome, it would be possible to carry much greater numbers of live stock than is at present possible.

The topography of the dry area provides facilities for the storage of water with a minimum cost of money and labour. The numerous coulees and water courses, if properly dammed, would provide a water resource, the value of which has yet to be realized. Why settlers in an area where moisture is the most important factor in farm production, have not made greater use of the coulees and surface run-off is difficult to explain.

The storage or use of water obtained from spring run-off or the occasional heavy rain may be conserved by means of storage reservoirs, dams or dikes. There is possibly no investment in farm improvement that will diminish the hazard of total crop failure, that will assist in maintaining a feed supply and insure a farm garden, etc., as will a small storage reservoir from which a few acres of

land may be irrigated, and in addition, provide a permanent water supply for live stock.

Where the farmer has a working knowledge of construction requirements of a satisfactory dam, there is no reason, if the natural facilities are available, why he should not erect such structures with his own labour and with a very limited outlay in cash. Such structures are permanent and enhance the value of the property. Disappointments growing out of the erection of dams is found to be due to faulty construction, the providing of inadequate spillway capacity and lack of width and strength to withstand the pressure of water impounded.

Dams should be located on tight soil to avoid seepage loss. There must be ample height, three feet above the normal water level, and the entire structure should be of generous proportions. In order to protect an earth dam from wave action and to establish permanency, the surface should be well rip-rapped with cobble stones. In some cases, small willow trees bound in bundles and held in position with racks can be used.

It is not desirable that the details of construction be dealt with here, any more than to point out that, if satisfaction is to be obtained, any structures erected for the conservation of water, must be built in accordance with good and well recognized construction practices and specifications.

One of the chief advantages of obtaining a water supply by the above means is that the water is brought to the point where it is to be used with a minimum of capital expense. Nature has provided the canals in the form of coulees.

Contour dikes can be effectively used to direct or conserve run-off water on land to be irrigated. This system can be most effectively used on level land coulee bottoms or adjacent to natural "draws." It is necessary that the water from the coulee be diverted from the water course by means of a diversion dam or ditch to the land to be irrigated. The contour dams are run on the level and built to a height varying from 12 to 18 inches, depending upon the slope of the land and the quantity of water to be impounded. Water may be impounded behind the dikes to a depth of 12 to 18 inches. When the check back of the dike is filled, the water runs over the dike into the next check, thus irrigating each check in turn in proportion to the amount of run-off. This system, of course, applies to small acreages only and, when properly installed, requires very little attention. If the first flood does not irrigate the entire area, the delivery can be set so that the water from the succeeding floods is directed to the lower checks which have not been irrigated, thus in time irrigating all the checks. By the above method land may be saturated during the early spring or summer months from run-off water, which would otherwise go to waste.

With the general improvement of the Diesel oil engine and the greater improvement of pumping units, the installation of small pumping units for irrigating land has become more practicable and more economical and is worthy of careful consideration as part of a water development programme for the dry area. Investigations reveal that modern Diesel pumping units, capable of delivering four second feet of water, with a moderate head and lift, are procurable at a cost of approximately $1,000.00 The fuel operating cost of such equipment would be less than twenty cents per acre foot of water delivered. This represents approximately an 80% saving when compared with ordinary gasoline internal combustion engine. Such equipment, if properly installed, is capable of irrigating at least 200 acres of land.

From a Provincial point of view, the development of water resources in the dry areas should be looked upon as a means of reducing relief hazards and promoting permanency of settlement and, particularly in those special areas where the lands are largely under public control. It would therefore appear that the development of such a policy where a community as a whole will receive the benefit might be advantageously included in a public works programme.

EDUCATIONAL PROPAGANDA AND DEMONSTRATION

The success of any venture which involves the co-operation of a large number of individuals for its success will depend to a large extent on how clearly the objectives to be gained and the method of attaining them are fixed in the minds of those who are taking part in the venture. The prairie farmer is a product of an individualistic system and up to the present time, has been comparatively free from regulation of any kind. He has been free to do as he liked, without

regard to whether the result of his actions is likely to affect adversely or otherwise, those whom circumstances compelled to move within the same orbit. One result of this lack of planning and lack of regulation is the settlement difficulties in the dry area to-day. These difficulties have made it necessary for the taxpayers of the Province as a whole to contribute several millions of dollars to the maintenance of the people in the dry areas. The situation is such that what is done in the dry area now is not only of importance to the people who live there, but to the Province of Alberta and to Canada. Twenty-five years of experience have demonstrated that the type of agriculture being carried on in the area was not the type for which it was best adapted. It is realized that a re-organization must take place—a re-organization which will not only completely change the basis of occupancy of land, but will change the social and economic life of the people. It will also affect such outside forces as financial interests, distributive agencies and machine companies. In order to succeed, the programme will need the whole-heated co-operation of the settlers themselves, the governmental agencies and the financial institutions. That being so, it is necessary that the actual facts of the situation, as far as past history, production capacity, debt structure and social organization be made known to all and all must be partners in building the new community. The Government is in the fortunate position of controlling approximately eighty per cent of the land within the Special Municipal Areas, thus giving a measure of control whereby the utilization of the land may be determined.

There has been a tendency to disregard the drought area farm problems. It is highly important that in any rehabilitation programme that due consideration be given to the agricultural problems peculiar thereto. To this end, it is suggested that, in every community, demonstrations in approved agricultural practices be carried on in the form of District Illustration Stations, such as are now being undertaken under the Dominion Government Prairie Farm Rehabilitation Act. Under this arrangement, a good farmer is selected in each district who agrees to follow out a definite programme with a view to determining the suitability of various farm practices and crops to the community. Such a programme not only would test out suitable farming practices, but would also take into consideration, range practices as well.

In these areas, special emphasis should be placed upon the need of a District Agent, not only because of the information that such an agent can impart as a trained agriculturist, but because of his services in organizing various activities, such as boys' and girls' clubs and community improvement associations, as a means of disseminating new information direct to farmers and others interested in the general improvement of the area. The agent's duty will be to try and build up a community consciousness and community pride to such an extent that the whole centre will function as a unit.

Special mention should be made of the services which are being rendered in the development of natural resources, such as are being performed at the present time by the Water Development Committee, which is functioning under The Prairie Farm Rehabilitation Act. This committee is prepared to give free services to farmers by assisting in designing small irrigation systems, locating and designing dams and development of reservoirs for stock watering purposes.

In conclusion, it should be once more emphasized that the problem of the dry areas is sociological as well as economic, and the solutions which are to be applied must take cognizance of these facts. If the area is to be looked upon as the home of a permanent self-sustaining population, and there is no reason why this view should not be taken, the settlement will have to be based upon a system of organization that permits first, the enjoyment of economic security and, second, the social, recreational and educational advantages common to the more favoured areas of the Province.

SUMMARY

The problem of proper land utilization is one of the major problems confronting governments today. This is true because the particular use to which any piece of land is put is governed by a large number of factors such as the climate, adaptability, market roads, marketing policies and export quotas.

Successful settlement can only be carried out where the land is sufficient in quantity and quality, and is so situated with respect to markets that people are able to maintain normal economic, social and governmental services. These conditions were not fulfilled in much of the area known historically as Palliser's Triangle, and the result has been abandonment of homes and the creation of an insurmountable debt structure.

The dry area of Alberta includes practically all of crop districts 1, 3, 5 and 7, and the eastern portions of districts 4 and 6. It is an area of light, brown soil which, in many places, will readily drift. Surface water, such as lakes and streams, is scarce and the area forms part of the great treeless plain of North America over which the annual rainfall is approximately 12 inches or less. Due to certain topographical features and the geographic position of the area, it is subject to recurrent periods of wet and dry years. These periods do not appear to follow any regular cycle, but tend to occur more often in groups of three to five years than otherwise. Past records indicate that contrary to a commonly expressed belief, the climate of the dry area is not changing. Much has been written about the planting of trees as a means of solving the drought problem in the dry areas. Those who advocate this policy are mixing cause and effect; trees are a product of rainfall rather than the cause. While it is true that forests may and do affect the humidity of the atmosphere, through the process of transpiration, there is no evidence to show that sufficient trees could be established in a semi-arid region to have any effect on the climate.

Farming practice in the dry area has been confined mainly to the production of wheat as the major enterprise with grazing restricted to the south-eastern corner of the area. Under the wheat farming programme no definite live stock policy was followed with the result that inefficiency in the use of feed supplies has been general. The result of the type of farming practiced and the dry conditions which normally prevail has been a rapid depletion of soil fibre and an increased tendency to soil drifting.

The problem of soil drifting is not peculiar to the western plains, but is found in any area where rainfall is limited and high winds pass over dry soil which is in a fine state of cultivation. Our system of crop rotation whereby one-half the land is in fallow each year, provides the ideal condition for drifting when other factors are favourable. It is seldom that any single control measure is entirely satisfactory for the control of drifting. Best results are usually obtained when a combination of measures are adopted together with timely and proper use of tillage machinery.

Generally speaking, three types of farming are carried on in the dry area—dry farming (wheat growing), a combination of wheat growing and ranching, and ranching proper. Of the three types, the rancher has generally been the most efficient, the wheat farmer next, and the farmer-rancher in bottom position, for the reason that more often than not he has been operating on too small a margin of capital.

The result of the settlement of an unsuitable area with the object of wheat growing, has been the accumulation of a tremendous private and governmental debt burden chargeable against the land. Detailed analysis of the debt structure reveals that, under the conditions of price and yield which have obtained in recent years, the farmers are rapidly losing whatever equity they had in their farms.

The social and community life, as well as the cultural standards of any given agricultural region, are likely to be profoundly affected by the system of land tenure and the physical organization of the land into holdings. The Homestead Act of 1862 has not proved a good basis of land organization in the dry areas, because it does not make for a satisfactory farm unit under dry conditions and it cannot make possible the most efficient use of existing natural water supplies. Under the conditions of sparse population existing in the dry area, the difficulty of maintaining the primary contacts of community life and the necessary social services is very great and very costly. If a permanent population is to be maintained on a self-supporting basis in the area, equal opportunities for education, medical and other community needs must be provided. This can only be done under some system of community settlement organization.

The basis of any new settlement policy should be the classification of the soil according to the use for which it is best suited. In this way, the territory would be designated as a wheat farming area, a mixed wheat farming and grazing area, or a ranching area. With the more extensive use of mechanized power in the farming area it would be possible to establish community centres. These community centres should be grouped around an adequate water supply and use should be made of existing railway, road, school, church and distributive facilities where possible. Such a type of settlement, whereby the farms were operated from the centre, would permit a normal community life and equal educational and recreational facilities with the more thickly settled districts of the Province.

The problem of successful settlement in the dry areas is as much a sociological problem as an economic one and, until such time as it is treated as such, no permanent solution will be provided. By a system of planned agriculture, which makes use of the best technical and scientific information available, together with the practical experience of past years, it is possible to lay down policies which, if intelligently carried out, will transform the dry area from a permanent relief area of primitive, pioneer conditions, to one of equal opportunity from the standpoint of educational and community life with those of the more densely populated and better agricultural areas of the Province.

RECOMMENDATIONS

1. That those sections of the dry area within the Province having unproductive soil, or unfavourable climatic conditions, or both, and which have proved to be unduly hazardous for farming purposes, be placed under the administration of The Special Municipal Areas Act.

(*a*) That in areas administered under The Special Municipal Areas Act, the granting of agricultural relief be discouraged and direct relief be substituted therefor, and that, co-incident therewith, a programme of improved farm cultural practices, development of water resources and small irrigation projects be inaugurated.

2. That the basis for the determining of the proper utilization of land in the dry area be a thorough and systematic classification of soil types.

3. That, in the rehabilitation of Special Municipal Areas, special consideration be given to the development of types of farming suitable to the various types of soil within the area.

4. That the agricultural policy of such areas give due consideration to:

(*a*) The economy and advantages of mechanization of wheat farms.
(*b*) The economy of large farm and ranch units.
(*c*) The reduction of live stock population well within the carrying capacity of the farm or ranch units.
(*d*) The enforcement of The Soil Drifting Act.
(*e*) The providing of storage for surplus feed and seed supplies, if any.

5. That, in order to make possible the improvement and reduction in cost of social, recreational and educational facilities, that opportunity be given the present population of the Special Municipal Areas to consolidate their place of residence in community centres by reserving lands adjacent to such community centres for such purposes.

6. That agricultural extension activities in the areas be carried out in the areas through the medium of district agriculturists and Dominion Illustration Stations, and that such services should stress:

(*a*) The significance of soil types in relation to types of farming and farm practices.
(*b*) The necessity of strip farming.
(*c*) The importance of timeliness when performing farm operations.
(*d*) The advantages and possibilities of the plowless summer-fallow.
(*e*) The most suitable types of farm machinery.
(*f*) The most efficient types of live stock.
(*g*) The most efficient methods of live stock management.
(*h*) The encouragement of the development of community centres.

REFERENCES

1. ALLAN, J. A. — Appendix II, Soil Survey Macleod, Medicine Hat and Sounding Creek Sheets, University of Alberta, College of Agriculture, Bulletins 11, 14 and 16.
2. ALLEN, W., ET AL — Studies of farm indebtedness and financial progress of Saskatchewan farmers. University of Saskatchewan, Agricultural Extension Bulletin 65, May, 1935.
3. ALLEN, W. — The farm business in Saskatchewan. University of Saskatchewan, College of Agriculture, Bulletin 37, Jan., 1927.
4. AYRE, ROBERT — Missing Moisture, Maclean's Magazine, Nov. 15, 1934.
5. BAKER, O. E. — The outlook for land utilization in the United States. U.S.D.A. Extension Director 168, 1931.
6. BAKER, O. E. — Regional changes of farm animal production in relation to utilization of land. U.S.D.A. Bureau of Agriculture, Economic Circular, Oct., 1929.

7. Cameron, D. — The cost of producing wheat in Alberta, University of Alberta, College of Agriculture, seminar paper, Feb., 1933.

8. Christenson, F. W. — Live stock feeding under drought conditions. North Dakota Agricultural College and Experimental Station, Circular 126, Nov., 1934.

9. Craig, Glen H. — Study of the farm business at Hilda and Irvine, Alberta and Bow Island-Foremost, Alberta. Incomplete report of Canadian Pioneer Problems Committee, 1931.

10. Evans, Sanford — Statistical Service. Drought areas of the prairie provinces, 1924 and 1934.

11. Hind, H. Y. — General Report on the Assiniboine-Saskatchewan Exploring Expedition. Appendix to the Journals of the Legislative Assembly of Canada, 1859.

12. Hopkins, E. S., et al — Soil Drifting control in the prairie provinces. Dominion Department of Agriculture, Bulletin 179, N.S., Ottawa, 1935.

13. Hopkins, John A. Jr. — Horses, tractors and farm equipment. Iowa State College Bulletin 264, June, 1929.

14. Hurd, W. Burton and Grindley, T. W. — Agriculture, Climate and Population of the Prairie Provinces, 1931.

15. Innes, Harold A. — Problems of Staple Production in Canada, 1935.

16. Lutz, J. Fulton — The physico-chemical properties of soils affecting soil erosion, University of Mississippi College of Agriculture, Research Bulletin 212, July, 1934.

17. MacIntosh, W. A. — Prairie Settlement, Vol. I., 1934.

18. MacIntosh, W. A. — Economic Problems of the Prairie Provinces, 1935.

19. Macoun, John — Manitoba and the Great North-west, Guelph, 1882.

20. Main, T. C. — Drought and soil drifting in Western Canada. Engineering Journal, June, 1932.

21. Mavor, James — Report to the British Board of Trade on the North-west of Canada. British Parliamentary Paper, 1904.

22. Moss, H. C. — Some field and laboratory studies of soil drifting in Saskatchewan. Scientific Agriculture, 1935.

23. Moynan, J. C. — Report of the Chief Supervisor, Illustration Stations. Dominion Department of Agriculture, Ottawa, 1930.

24. Palliser, Capt. John, — Journals, Detailed Reports and Observations Relative to the exploration of that portion of British North America during years 1857-60. Report to British House of Parliament, May, 1863.

25. Sackville, J. P. — Correspondence on live stock feeding requirements. University of Alberta, June, 1935.

26. Shaw, A. M. — Drought on the Canadian Prairies. University of Saskatchewan Extension Circular, Nov., 1934.

27. Sloan, Sam — Soil Drifting Control.

28. Starch, E. A. — Farm organization as affected by mechanization. Montana State College, Bulletin 278, May, 1933.

29. Stuart, Maj. Duncan. — The Canadian Desert, 1934.

30. Thompson, L. B. — Feeds for wintering cattle in the dry area. Dominion Range Experimental Station Mimeograph, Manyberries, Alberta, 1934.

31. Westbrook, Laurence. — Rehabilitation of stranded families. The Annals, 1934.

32. Wyatt & Newton — Soil survey of Macleod Sheet. University of Alberta, College of Agriculture, Bulletin II, Sept., 1925.

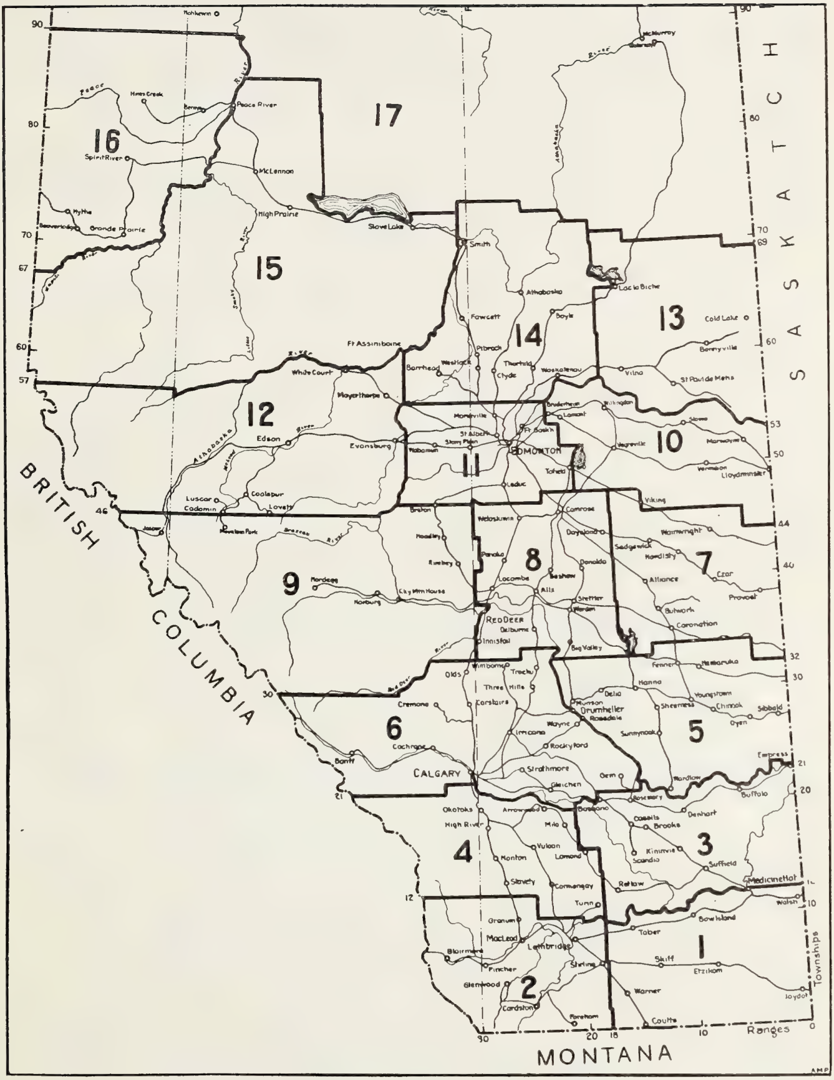
33. Wyatt & Newton — Soil survey of Medicine Hat Sheet. University of Alberta, College of Agriculture, Bulletin 14, Dec., 1925.

34. Wyatt & Newton — Soil survey of Sounding Creek Sheet. University of Alberta, College of Agriculture, Bulletin 16, Dec., 1927.

35 Report, Western Canadian Society of Agronomy, 1920.

36. The Special Areas Act Vol., Statutes of Alberta, 1935.

37. Tilley East Area Act Vol., Statutes of Alberta, 1929.



BRITISH COLUMBIA
MONTANA
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Townships
EDMONTON
CALGARY
Red Deer
Lethbridge
Medicine Hat
Drumheller
Peace River
Grande Prairie
Spirit River
McLennan
High Prairie
Slave Lake
Athabaska
Lac la Biche
Cold Lake
Edson
Jasper
Banff
Cochrane
Camrose
Wainwright
Coronation
Hanna
Brooks
MacLeod
Cardston
Pincher
Coutts
Lloydminster
Vermilion
Vegreville
Viking
Stettler
Olds
High River
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Okotoks
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1935

CHAPTER 40.

An Act to Encourage Methods of Cultivation to Control Soil Drifting.

(Assented to April 23, 1935)

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Alberta, enacts as follows:

1. This Act may be cited as *"The Control of Soil Drifting Act."* Short title

2. It shall be the duty of the occupier of land which is being summer-fallowed to till the same in such a manner as to prevent soil on any part of the summer-fallowed land from drifting so as to cause damage to adjacent land and property. Duty of occupier in tilling summer-fallow

3. The occupier of any land which is being summer-fallowed, shall be deemed to have discharged the duty imposed upon him by this Act if each quarter-section upon which land is being summer-fallowed is cultivated according to any of the methods following, namely: Methods of cultivation satisfying duty

(*a*) By summer-fallowing and cropping the land in alternate strips not exceeding twenty rods in width approximately at right angles to the prevailing direction of wind liable to cause soil drifting; or Strip cultivation

(*b*) By surrounding all summer-fallowed land with a strip of land of at least thirty rods in width cultivated in three strips paralleling the edge of the summer-fallow of which the inside and the outside strips are each at least ten rods in width and are either under a grain crop or in stubble, and the remaining strip is summer-fallowed; or Surrounding summer-fallow with strips of grain or stubble and summer-fallow

(*c*) By surrounding all the summer-fallowed land with a strip of land of at least thirty rods in width paralleling the edge of the summer-fallow which is under a growing crop of grain or which is in stubble; or Surrounding summer-fallow with strip under grain or in summer-fallow

(*d*) By seeding upon the land a covering crop of grain sown not later than the tenth day of August, using for that purpose not less than twenty pounds of seed per acre on all of the land which is under summer-fallow, or by seeding the land to fall wheat or fall rye on or before the first day of September; or Cover crops or fall seeding

(*e*) By maintaining a strip of natural or planted tree growth at least three rods in width within forty rods of and along the whole of each boundary of the property. Tree growth

4.—(1) Subject to the other provisions of this section, the occupier of any land in respect of which the duty imposed upon the occupier of land by this Act is not discharged, shall be liable to the owner of land and to the owner of crops which are damaged by soil drifting except only when the land upon which the damage occurs or any part thereof, is being summer-fallowed and the duty imposed upon the occupier by this Act in respect of that land is not discharged. Liability of occupier for damage to land and crops

(2) The liability of the occupier for damage shall not exceed the sum of one hundred dollars for each parcel of land occupied by him and upon which soil drifting occurs which is a quarter-section, and in case the parcel contains less than one hundred and sixty acres, a sum bearing that proportion to the sum of one hundred dollars which the acreage of the parcel bears to one hundred and sixty acres. Maximum liability

5. Any person, who is the owner of any land or of any crops damaged by soil drifting to whom an occupier is liable under section 4 of this Act to pay damages, may recover the same by action brought in the District Court of the district in which the land upon which the damage occurred is situate, on behalf of himself and all other persons to whom the occupier is similarly liable. Recovery of damages

6. No claim under this Act and no action so brought shall be settled or compromised without the approval of the Judge of the said District Court, and any settlement or compromise effected without Approval of settlement or compromise of claim

that approval shall not relieve any person liable from any liability under this Act to any other person or persons not party to the settlement or compromise.

Notice to others entitled to recover damages

7. Before proceeding to approve any compromise or settlement of any claim under this Act, the Judge shall require notice to be given to any other person who may be entitled to recover damages on account of the soil drifting which is the subject matter of the compromise, settlement or action.

Prima facie evidence

8. The fact that any land or any crop damaged by soil drifting is to the leeward of the wind prevailing at the time the soil drifting occurs shall be *prima facie* evidence that the land or crop was damaged by reason of the soil drifting from adjacent land situate to the windward thereof.

Abatement of claims

9. In case the damage caused by soil drifting from any lands is in excess of the sum of one hundred dollars for each quarter-section upon which the soil drifting occurred, or in case a parcel is less in area than a quarter-section such lesser sum as provided in section 4, the aggregate amount of all such claims shall be abated accordingly and the amount of each separate claim shall be abated rateably.

Priority of payment to claimant

10. Notwithstanding the provisions of any other Act, the total amount of the damages payable under any judgment in any action brought under this Act shall be payable to the claimant entitled thereto without regard to any of the other creditors of the person liable therefor and shall be payable in priority to all claims enforceable by execution other than claims of the Crown, municipal taxes, school taxes, drainage or irrigation rates and wages.

Voidance of tenancy or agreement for sale upon failure to comply with Act

11. It shall be deemed to be a condition of every letting, whether oral or in writing, and every agreement for sale of any land that the tenant or purchaser shal in summer-fallowing the land, comply with the requirements of this Act, and if upon the breach of that condition soil drifting occurs upon the land, the lessor or the vendor, as the case may be, shall be entitled to forthwith declare the tenancy or agreement for sale at an end and to recover the possession of the land comprised therein.

12. For the purposes of this Act any person or corporation who has the control and management of any highway shall be deemed to be the owner of the road allowance upon which the highway is located and every person or body who is the owner or has the management or control of any irrigation ditch or drainage ditch shall be deemed to be the owner of the land which forms the site of any such ditch.

Areas excluded from force of Act

13. The Lieutenant Governor in Council may, from time to time, define any part or parts of the Province as areas within which this Act shall not be in force, and upon the publication of any order so made in *The Alberta Gazette*, this Act shall not be in force in the area defined therein.

Coming into force of Act

14. This Act shall come into force on the first day of March, 1936.

PART II

CROP INSURANCE

CROP INSURANCE

During the past quarter of a century, tremendous strides have been made in the application of science to agriculture. Plant breeders have developed varieties of cereals, vegetables and fruits that are much better adapted to special conditions of growth than those that were grown 25 and 30 years ago. In the same period engineers have developed methods of handling these crops from seeding time to harvest time which have enabled the farmer to dispense with much of the expense and drudgery that characterized farm labour in the last century. Yet in spite of all the application of scientific knowledge to the art of farming the farmer is still in the position of being unable to definitely count on a stable income from his labour over a period of years. In a year when the ravages of rust, hail, frost, and insect damage have caused a colossal loss, that is variously estimated at from 200 to 250 million dollars to the farmers of the western prairies, there are those among us who question the value of the contribution that science has made to agriculture. They ask, is it worth the cost? The answer is obvious. Of course it is. Scientific agriculture has paid huge dividends and put millions of dollars in the pockets of western farmers, but as yet, it has not devised any scheme of eliminating the hazards to a growing crop contained in the elements of nature. In every other industry where natural risks are involved, various methods of distributing the risk have been evolved through some form of insurance. This has not been done in the case of the country's largest and basic industry, and a possible explanation is that, in the first place, crop insurance is a most difficult kind of insurance to work out equitably, and secondly, it is only in comparatively recent times that crop production has been looked upon as a big business enterprise subject to all the fundamental economic laws that govern any other industry. In times past, farming has been looked upon as a subsistence occupation in which the individual operator farmed to live and not for profit. Increasing specialization and the opening up of areas limited by geographic and climatic considerations to the production of a limited variety of crops has changed the situation as far as the farmer located in those areas is concerned. He is now perforce compelled to apply the same principles to his business of farming as he would to any other.

It has been common to speak of the farmer as the most independent member of organized society. In the social sense, this is essentially true because the farmer who owns his land is less directly dependent upon the goodwill of his fellow men and under less obligation to cater to their whims and prejudices than is the man who follows a professional or commercial pursuit. But though the farmer enjoys a comparatively high degree of independence in his social and business relations, his economic status is to an unusual degree directly dependent upon nature.

Factories, mills and stores will continue for a time at least to function undisturbed by weather conditions or other natural agencies that have seriously damaged or entirely destroyed the farmer's crop. It is only when these agencies have destroyed crops over a wide area, that business and professional men suffer severely.

The farmer may bring to his enterprise abundant energy and good judgment and be rewarded one year with a bountiful harvest while, in the next two years, his best efforts are nullified through drought, hail, frost, insects, or a fall in price. Viewed broadly, then, what the farmer greatly needs to-day is some assurance of stability of income each year. It is far better from an individual and social point of view to have an annual income of $3,000, than to have two years of $5,000 followed by three years of $1,000 each. In the first instance, the farmer is dealing with a stable condition of income and can plan accordingly; in the second, artificial stimulation of prices is likely to result with a subsequent reaction in the years of small returns.

THE FUNCTIONS OF CROP INSURANCE

According to Valgren (6), "the primary function of insurance is to distribute the weight of loss burdens originating in economic risks so that the destructive force of such burdens will be lessened if not eliminated . . . . . . In a certain sense, by giving place and time distribution to loss burdens, insurance eliminates or reduces risks. The assumption of a given class of risks for each of a large number of individuals brings the law of averages into play in such a way that the losses from these risks become mathematically predictable within reasonable limits, and can, therefore, be planned for or provided for in advance of their occurrence."

FACTORS AFFECTING THE INSURABILITY OF DIFFERENT TYPES OF RISKS

In any discussion of crop insurance, it is necessary to keep in mind the basic principles and concepts which govern insurance generally because they apply with equal force regardless of their field of application.

First, a risk does not lend itself well to insurance unless data are at hand from which the probability of loss can be established with a fair degree of accuracy. Where sufficient data covering a long period of years is available, it is possible to predict within reasonable limits of accuracy what the aggregate or total loss is likely to be in any one year, even though the amount, time, and place of any single risk is unpredictable. Generally speaking, losses are more predictable in the aggregate if they involve only natural forces or agencies beyond human control.

Secondly, it is a well recognized fact that insurance against losses that are both minor and frequent, tends to cost more than it is worth.

Third, any risk which depends in part upon the conduct of the one who bears it, is generally considered uninsurable unless increasing the risk and wilfully bringing about an insurance loss involves some sacrifice on the part of the insured that he will be unlikely to make.

FACTORS AFFECTING THE COST OF INSURANCE

The primary factors affecting the cost of insurance have to do with the frequency and size of the losses in relation to the total values insured. But, in addition to these, the expense factors involved in inspection, underwriting, record-keeping and adjustment, are very important and must be carefully considered in the expense loading or overhead that must be added to the net premium necessary to cover the actual losses themselves. The moral hazard on the part of the insurance organization's employees and on the person who is insured, and the economy and efficiency with which the organization operates, are also important cost-affecting factors.

SPECIAL CHARACTERISTICS OF AGRICULTURAL RISKS

When considered in relation to other forms of risks, it will be readily seen that agricultural risks such as would be incurred under a plan of crop insurance have certain special characteristics. Among the leading ones are the relative uniformity and smallness of these risks in terms of dollars and cents. Their wide territorial dispersion and their relative isolation are other outstanding characteristics that no doubt account largely for the fact that regular commercial insurance interests have given relatively little attention to this type of insurance. Another difficulty that presents itself in considering crop insurance is that it is a highly specialized kind of insurance, calling for special qualifications on the part of those who are entrusted with the writing and supervision of the business. In the case of fire and windstorm insurance, where the similar characteristics apply, greater success has been attained through the action of comparatively local organizations functioning along co-operative principles, than through large and distantly located commercial agencies.

The final characteristic of the risk in crop insurance is that often the farmer is subject to losses from hail, wind and frost which are relatively insignificant and it is often cheaper for him to carry his own loss than to distribute it through an insurance organization; thus, a special requirement is that the insurance must be limited to essentials and be provided at a very low cost.

THE ACTUAL BASIS FOR CROP INSURANCE

It is generally agreed by such insurance experts as Hoffman (4) and Valgren (6), that the success of any plan of crop insurance will depend upon the actuarial basis upon which it is built. Before embarking on any scheme of crop insurance, Hoffman (4), gives it as his opinion that it would be advisable to have records of weather hazards, crop yields, and prices for a period of 30 years, and statistics on the factors of plant diseases and insect pests for 20 years. With such long-time records at the disposal of an organization, it would be possible to get a fairly accurate picture of the losses that might be expected to occur on the average, from any one of a number of causes. Such records would also indicate whether it would be advisable to divide a given insurance area into zones rather than deal with it as a single unit under a form of blanket coverage. They might also indicate whether or not it would be advisable to select certain crops for insurance rather than others.

THE STATUS OF CROP INSURANCE TO-DAY

The question of crop insurance which has been very much to the fore in the minds of farmers and politicians during the past year in the Province, is by no means a new topic of discussion. It has been considered speculatively at least for quite a number of years. While crop insurance in Canada, other than hail insurance, has been tried in a very limited way, records indicate that a system of blanket coverage against crop loss was instituted in a small way in the state of Kansas in 1899. The next attempts on any appreciable scale to institute a system of insurance against crop loss in the major crops were in the states of Kansas and Dakota in the years 1917 and 1920. Neither of these ventures were successful, partly because the projects were launched without having sufficient statistical data to serve as a reliable guide in allotting premiums and risks, and partly because the work was carried on as a sideline by regular line fire insurance companies through their regular agents who were not qualified to deal with a type of insurance which possibly more than any other, requires special training on the part of the agent.

Following these pioneer experiments, efforts were directed to the provision of insurance in the citrus fruits and truck gardening industries of the Pacific coast and the southern states, with particular attention given to the single hazard of frost. While these attempts were not particularly notable from a financial point of view, they did not result in the heavy financial loss to the sponsoring companies that characterized the Kansas experiments. At the same time they showed promise of this becoming a practical field of insurance if certain weaknesses were corrected.

By the end of 1928, three companies, exclusive of those engaged in the hail insurance business, continued to write crop insurance on selected crops in selected areas. The coverage given by these companies included insurance against drought, excess moisture, plant diseases, insect damage, hail and frost. In other words, it was the broad type of coverage that is now generally referred to as crop insurance. The areas and crops covered by this insurance were; citrus fruits in Florida, truck crops in the Carolinas and Georgia, rice and sugar cane in Louisiana, Texas and Arkansas. On the Pacific coast, insurance has been written covering citrus fruit in the southern portion and on grain and deciduous fruits in the states of Washington, Oregon and Idaho. The amount of insurance written covering grain crops in the Pacific coast states was never great and, at the present time, nothing is being done on those crops.

The latest attempt to provide a system of insurance for grain crops, took place in Kansas in 1932, where A. L. Sowers of Berryton, worked up an organization which wrote a type of income insurance on a rather conservative plan. 1932 was an unfortunate year for the start of such a venture because the price of wheat fell to as low as 20 cents per bushel net to farmers in outlying districts. The result was that Sowers organization was unable to pay its losses in full. Since 1932, he has been making attempts to revive the organization but without much success.

From the foregoing record of experiences, it is evident that there is at the present time, no general plan of crop insurance in effect on the American continent. The results so far obtained have been mostly negative and from this it may be

concluded that crop insurance is still very much in the experimental stage. On the positive side, however, a vast deal of valuable information has been gained which reveals only too plainly the weaknesses that must be guarded against in the setting up of any broad type of crop insurance.

THE MEANING OF LOSS OR DAMAGE IN GROWING CROPS

Having set forth the fundamental principles on which crop insurance is based, and having reviewed its development to date, it might be well to clearly define the terms "damage" and "crop loss" as used in connection with growing crops. A good illustration to explain these terms is used by Valgren (6) and with slight changes it will serve our purpose here.

Assume, for example, that with ideal climatic conditions and the absence of other loss-producing agencies, such as insect sand plant diseases, three farmers, A, B, and C, located at Barons, Red Deer and Fort Saskatchewan, produce respectively, 40 bushels, 50 bushels and 35 bushels of wheat per acre in a given year. The next year, because conditions are not as good, A, located at Barons, only produces 10 bushels per acre because of drought; B, at Red Deer, only gets 15 because of hail; and C, at Fort Saskatchewan, only gets 20 because of frost. Taking into consideration the loss due to damage from all causes or combinations of causes, these three farmers in a certain sense may claim losses of 30, 25 and 20 bushels, respectively. In other words, they failed by the amounts given to obtain the maximum crops that would have resulted from the expenditure of their capital and labour had not weather conditions and other natural agencies been adverse.

Another illustration can be applied particularly to wheat growing in the dry area. Let us assume that three farmers, X, Y and Z, are growing wheat at Hanna, Empress, and Vulcan and that the average yield in each of these districts for the past 20 years has been 12 bushels per acre. Let us also assume that this yield at the price received, has given sufficient to cover all production costs against an acre of wheat. On each farm at various times, 35-bushel yields have been harvested, Y, at Empress, having received this yield last year. Now let us consider a particular year. At Hanna, where X farms, conditions are average and he gets a 12-bushel yield. In Y's country at Empress, the season is particularly unfavourable. A late cold spring is followed by a late spring frost and then by drought, with the result that the crop is a complete failure. In Z's district at Vulcan, conditions are particularly favourable and within two weeks of cutting time he has a 35-bushel crop in prospect. At this time, a hailstorm passes through the district causing a 60% loss, with the result that, instead of getting 35 bushels, he gets 14.

If we limit the consideration to returns from this particular year and think now in terms of actual income rather than prospective income, we find that farmer X at Hanna, with his 12-bushel yield, had neither profit nor loss—he simply broke even on his year's operations. Farmer Y at Empress, through frost and drought, reaped no harvest whatever and consequently suffered a loss equivalent to his entire labour, seed and land rental charges. Farmer Z at Vulcan, in spite of the hailstorm and a 14-bushel yield, had a few cents over and above his operating costs and thus had a profit.

Now, if we consider the matter from the standpoint of prospective yield and income instead of actual income, the situation changes, because only for the interference of climatic factors, it would have been reasonable to expect that all three would have had 35-bushel crops. In this respect then, all three can claim to have had a loss. This is particularly apparent in the case of Z at Vulcan, who had a definite prospect of 35 bushels per acre which was reduced to 14 by hail, thus causing him a loss of 21 bushels per acre. If he had carried hail insurance, he would have been entitled to indemnity of 60% of the insurance carried under the present plan of settlement. From this, it must be conceded that Z suffered a recognized form of loss, even though the loss related to wheat in prospect rather than wheat in actual existence. The fact that Z's loss was sudden and spectacular does not make it materialy different from the loss suffered by X and Y. In each case, it was wheat in prospect rather than wheat in the bin that was lost.

From these illustrations it becomes apparent that the word "loss" in connection with crops may have either of two different meanings. The kind of loss suffered by Z when his prospective 35-bushel yield was reduced by hail to 14, as well as the less spectacular but more severe loss which reduced X's crop from 35 to 12 bushels, is best termed "crop damage" by way of distinguishing it from the kind of loss suffered by Y, which was not only crop damage or a reduction in prospective yield, but a "financial loss" on the season's operations.

Adhering to this terminology, X and Z suffered crop damage on their wheat although it was not severe enough to prevent X from breaking even and Z from making a small profit. Y, on the other hand, suffered crop damage which resulted in a financial loss equal to his entire operating costs in connection with the crop. Similarly, in the first illustration, farmers A, B and C suffered crop damage although each may have been able to show a profit on the year's operations.

It may be argued that the idea of crop damage here set forth is faulty because it assumes that the best crop yet harvested was a perfect or no-damage crop. This difficulty has been overcome by the United States Department of Agriculture through the device of assuming that a crop which exceeds the normal yield by 10% is a perfect or no-damage crop for a given district. The reason for raising the normal yield by 10 per cent is to make allowance for the fact that the yield which the crop reporter has in mind as the normal yield for his district, is not strictly a perfect or no-damage yield; he is usually thinking in terms of a good rather than a bumper crop. On this basis the difference between a perfect no-damage yield and the actual yield is the measure of total crop damage.

TYPES OF CROP INSURANCE

Self-Insurance

In considering any plan of insurance, it is always well for the farmer to first carefully consider what steps he can take to eliminate risks within the confines of his own farm organization before becoming part of a project which includes either a part or the whole farming community. Such provisions as he may make would come under the heading of self-insurance and would include such things as diversification of crops and enterprises. Even in districts that are by nature limited to the production of a narrow range of crops, it will be found possible by careful thought and planning to avoid entire dependence on one crop. In other districts more generously endowed by nature, it will be possible to eliminate risk by having a number of crops and also by having live stock of various kinds along with the main enterprise.

The one-crop farmer is always exposed to the possibility of having the entire results of a year's work destroyed by any one of several natural hazards, and while it is true that the diversified farmer may sometimes find himself in the same position, it is a rare occurrence when the effects of a single hazard will equally affect a number of crops. The same plant diseases and the same insect pests rarely, if ever, affect all the crops that can be grown in a given locality at the same time.

By a study of such meteorological data as the average length of the frost-free period in a district, the recorded dates of the earliest killing frosts, and by the use of generally recommended farm management practices, it is possible for the operator to greatly reduce the risks to which he is exposed. Such emphasis is being placed on this type of self-insurance to-day that certain bankers insist on a measure of diversification and the use of sound management practices as a prerequisite to the extension of credit facilities. There is also the added factor to consider that the measure of protection which the farmer can attain through his own unaided efforts is the cheapest insurance that he will be able to buy.

Insurance Contracts

The records of crop insurance experiments that have been tried up to the present time indicate that three main types of contracts have been used.

The insurance offered by the first contract covered all the hazards to which crops are subject with the exception of fire, flood, winter-kill and failure on the part of the farmer to properly till and care for his crops. The hail hazard was specifically included. The amount of insurance was fixed at $7 an acre and applied to a specified field area on which any of the following crops would receive coverage: wheat, flax, rye, oats, barley and spelts. In case of total failure of the crop on such an insured area, the company agreed to pay the face value of the policy, or $7 an acre. In the event of partial loss, the indemnity provided for was equal to the difference between the value of the crop on the field area insured and the face value of the policy, it being stipulated that the entire area insured in a given policy should be considered a single risk. Furthermore, the partial crop was valued at prices stipulated in the policy, namely, wheat $1,00, flax $1.75, oats and barley 50 cents a bushel. The insurance, therefore, even though written in terms of money, covered yield rather than returns on a monetary basis. In other words, the insured was protected against crop damage, but not against a possible drop in prices of the crop produced. Adjustment of all partial losses was necessarily postponed until after the insured crops had been threshed.

A second type of contract extensively written in 1920 is described by Valgren (6) as in effect guaranteeing the farmer a specified income from each acre insured unless damage results from hail, wind, tornado, failure of the seed to germinate, or failure on the part of the farmer to properly do his part in seeding, cultivating, or harvesting the crop. Losses or damage through the elements, including frost, winter-kill, flood and drought, and from insects or disease, are specifically covered by the policy.

The amount of insurance to the acre is based on the investment in the crop as determined by allowing a fixed amount for each process in preparing for, cultivating, and harvesting the crop, plus an allowance for seed and rental value of the land. Unlike the first contract, this policy does not place a fixed value on the grain harvested, but provides for valuation on the basis of market price at the time of adjustment. Thus the company is in effect giving protection against a drop in prices, as well as crop damage. This particular feature was responsible for a very heavy financial loss to the company in 1920, because of the very heavy drop in prices.

A third and more recent type of policy which gave practically the same coverage as the preceding one (both excluded hail, which would have to be written as a separate contract) states that the maximum amount of insurance to the acre that an applicant can carry is to be based on a certain percentage of his average yield during the past five years, this part being translated into dollars by applying to it the average price per bushel which obtained during the same five-year period. Thus, if a farmer had averaged 24 bushels of wheat per acre or over, for five years, he might be offered insurance in the amount of 18 bushels, and if the average price was 50 cents per bushel, his maximum insurance would be placed at $9.00 per acre.

The most important difference between this policy and those previously described is the plan provided for settlement of losses. In the case of total destruction of the crop, the company agrees to pay 75 per cent of the cost of field operations actually performed, such indemnity not to exceed 75 per cent of the total insurance carried. It is further provided that indemnity shall in no case exceed the cost of replacing all or any part of the quantitative returns on which the insurance is based with products of like kind and sound quality. Finally, it is provided that indemnity shall in no case exceed the amount, if any, by which the amount insured exceeds the market value of the crop harvested. Under this provision, a change in price in either direction may be taken advantage of by the company.

So far, three relatively distinct forms of crop insurance policies based on the methods of determining the amount of insurance to the acre and the indemnity due when losses are incurred, have been outlined. Under the first plan, the amount of insurance per acre is made an arbitrarily fixed and uniform sum for each acre insured. Under the second, the maximum amount written per acre is determined on the basis of the actual investment in the crop by placing a specified value on each operation in preparing the soil and harvesting the crop, and adding to this sum an allowance for seed and rental value of the land. Under the third plan, the average yield on the insured land for the past five years, together with the average price of the product for the same period, is made the basis for determining the amount of insurance.

The first method has the advantage of extreme simplicity, but it is obvious that the unmodified plan could not be applied to a wide range of crops in different sections of the country without greatly under insuring some risks and over insuring others. For general application, some method of adjusting the amount of insurance per acre to the investment involved, or the crop value, is essential.

The question may now be raised; is the investment in the crop as represented by the cost of field operations, plus seed and rental, or the average income over a period of years, as determined by yield and price, the better basis for arriving at a safe and poper amount of insurance to be written? As between the last two methods, the first is the easier to apply as far as the agent writing the insurance is concerned. In the second policy, the cost of the vaious farming operations is readily translated into dollars by means of simple tables showing the cost of each operation. The cost of seed and the rental value can also be readily determined. The weakness of the plan is that it does not lend itself to a ready differentiation between good and poor farming. In other words, the poor farmer who skimps his labour and uses poor seed and untimely methods, is likely to receive the same amount of insurance as the man who has made a study of his business and uses the most approved methods.

The last method of yield and price is somewhat cumbersome and difficult to apply. In the first place, comparatively few farmers keep records showing what

their past production has been, and in the second place, tenant farmers may not have operated the farm they are living on for a sufficient number of years to have necessary records, even if they were in the habit of keeping them. The plain has the merit, however, of measuring past results in so far as it is possible to secure the facts, and these form the most reliable results which are the subject of the contract.

Brief and simple illustrations of how the three contracts would work out in actual practice will help to make their difference clear, the figures used being those that work out most readily, rather than actual prices of to-day.

In the case of the first contract, a farmer insures his wheat at $7 an acre. The wheat is valued by agreement in the policy at $1 a bushel. By reason of drought or other cause, the yield is reduced to 5 bushels an acre. The indemnity due under these conditions is $2 an acre, regardless of whether the local market price of wheat at harvest time is $0.75 or $1.50 a bushel. If the lower price prevails, however, the farmer will receive only $3.75 for the 5 bushels harvested, while he will receive $1 a bushel for each of the two bushels that he fell short of 7 bushels, the quantity in effect guaranteed him. His total income an acre will be $5.75. If, on the other hand, wheat sells for $1.50, the amount harvested will be worth $7.50, equal, with the $2.00 indemnity, to $9.50 an acre. To the company, however, it makes no direct difference whether prices advance or fall except as the collection of premiums not fully paid in advance may be affected.

In the case of the second form of policy outlined, the situation becomes essentially reversed. Assume that a farmer insures his wheat at $12 an acre under this plan, which, as against the hazards covered, guarantees him a yield that at market price will equal the amount of insurance. In case of total descruction of his crop, he will be paid for such operations and such investment as have been already made in connection with the destroyed crop. Suppose, however, that by reason of one or more of the hazards insured against, the yield is reduced to 8 bushels. If the wheat at harvest time sells for $1.50 or more, no indemnity will be due, since the amount harvested will bring a return equal to or greater than the sum stipulated in the contract. But suppose, on the other hand, that wheat falls to $0.80. The 8 bushels harvested will then be worth only $6.40, and the indemnity due will be $5.60 an acre. On the basis of this price, even a 12-bushel yield will call for an indemnity, assuming that damage has occurred from hazards covered by the contract, equal to the difference between $12 and $9.60, or $2.40 an acre. To the farmer suffering crop damage from causes covered by the contract in such degree that his actual yield at market price falls below the insurance an acre, it makes no difference under this plan whether the price is higher or lower. To the company, on the other hand, high prices mean few and small losses, while low prices mean numerous and relatively large losses.

Turning now to the third and last form of contract previously outlined, conditions based on fluctuations in price take on still another aspect. Under this plan, the company in effect reserves to itself the right to make settlement in kind on the basis of the average yield used in determining the insurance an acre, at the same time retaining the option of settling the claim on a basis of dollars an acre with the crop valued at market price.

Assume again that a farmer carries insurance of $12 an acre on his wheat, this figure in this instance having been determined by taking three-fourths of a 16-bushel average yield and an average price of $1 a bushel. Owing to one or more of the hazards insured against, the yield, as in the preceding illustration, is only 8 bushels an acre. Assume first that wheat following harvest is worth $1.50 a bushel. The company, of course, invokes the clause in its contract providing that its liability shall in no case exceed the amount, if any, by which the amount insured exceeds the market value of the crop harvested. Since the value of the 8 bushels harvested is $12, no indemnity is due. But suppose, on the other hand, that the price following harvest is only $0.80 a bushel. The company then relies on the provision that in no event shall its liability under the contract exceed the cost at the time of harvest to replace all or any part of the estimated yield with products of like kind and sound quality. The company, therefore, tenders the insured the equivalent of 4 bushels at $0.80, or $3.20. This sum, together with the 8 bushels harvested, also at $0.80, makes the gross returns to the insured $9.60 an acre.

Had wheat remained at $1 a bushel, the indemnity would, of course, have been $4 an acre, but with a market price at harvest time standing at $1.50, the company pays nothing and with a market price of $0.80, it pays only $3.20. As in the case of the preceding plan of contract here considered, the company has fewer losses by reason of the rise, while such losses as occur are reduced in amount. In the case of this last form of contract, however, the company benefits from a fall in

price, as well as from a rise, while the insured who suffers damage has his indemnity reduced in proportion as the market price is lower than the price on the basis of which the amount of insurance was determined.

It should perhaps be pointed out in this connection that such changes in price as have been used in the illustration are decidedly abnormal, and that under relatively stable price conditions the third form of contrat would be practically as advantageous as either of the other two. There is serious danger, however, that the applicant for insurance will not read his contract and will not have his attention called by the agent to the plan of settlement, so that when changes in price occur he will be expecting in case of loss an indemnity sufficient to make his income equal to the insurance an acre specified in dollars on the face of the policy.

Dropping this third plan of loss adjustment from further consideration, the question still remains: Should the company writing crop insurance assume a material part of the risk involved in a drop in prices as well as that of crop failure, or should in effect yield only and not income be insured? Much can be said in favour of either of these two plans.

The first plan is more simple to administer, since, the value of the crop being agreed upon in the contract, there can be no haggling over which one of continuously changing market prices shall be used in the settlement. Furthermore, the farmer and not the company determines what crop shall be planted and insured. The adjustment of supply to market demand is, therefore, in the hands of the farmer, and it may be argued with much plausibility that where the control is, there must responsibility also lie. The weakest point in the plan is perhaps the fact that when the market price falls below the price stipulated in the contract, it becomes actually profitable for the farmer to have a damaged crop still further reduced in yield, since for the differences between the actual yield and the guaranteed yield, he is compensated on a basis of a price higher than the one he receives for his actual yield.

In favour of the second plan, which guarantees income rather than yield, it may be said that the affairs of the farmer are adjusted on the basis of an expected income. Furthermore, the guaranteed income is presumably limited to such an extent that the farmer will invariably hope and expect to exceed it. He will, therefore, exercise the same judgment in the adjustment of his various crops to prospective demand as though he bore the entire responsibility for financial results. Objection to this plan is likely to come from the company rather than from the insured.

According to Hoffman (4), some of the contracts offered, particularly the Pacific Coast type, are drawn up in such a manner that different hazards are grouped in different sections and the farmer can insure under those clauses which cover the hazards peculiar to his own district. For example, section "A" of the contract may cover hail, rain, wind, heat, flood, disease and pests, while section "B" covered drought or subnormal precipitation and section "C" might cover frost and so on. The basic rates charged under each section might be $2.00 or $2.50 or some such figure per $100 of coverage. If the farmer took the coverage offered under all sections, his premium per hundred dollars of insurance might vary from 5 to 18 per cent, depending upon the locality. Under this particular type of contract, Hoffman (4) states that the premiums charged have shown wide variation, ranging from as low as 25 cents per $100 of insurance for risks included under some sections of the contracts, to as high as $18 per $100 if all hazards were covered.

ALTERNATIVE PLANS—FARM STORAGE

It is generally agreed by all shades of opinion that there is a great need to-day for stability of farm income. It is also agreed that the problem will not be satisfactorily solved until it is handled on a nation-wide scale, but in view of past experience, there is a very real difference of opinion as to whether crop insurance is the ultimate solution. In view of that uncertainty, some consideration should be given to alternative schemes which, although not offering the same degree of protection in the event of loss of crop through natural hazards, at the same time offer a partial solution of the problem and reduces the expense normally associated with supplying the needs of a distressed community.

It was in recognition of the imperative national need of stabilizing farm income that the United States Congress passed the Agricultural Adjustment Act in the Spring of 1933. The people who drew up this Act were not at the time thinking as much in terms of providing compensation for crop loss as they were of compensation for fall in price, but the machinery which they set up was effective in taking care of both emergencies.

The situation that led to the enactment of the AAA legislation was briefly this. In the Spring of 1933, half the world wheat surplus, about three times the normal amount, was concentrated in the United States. Coincident with this unprecedented carryover, world prices had dropped to the lowest level in history, and approximately 1,000,000 wheat growers faced certain ruin. As a result of that situation, Secretary of Agriculture Wallace called together the representatives of all the general farm organizations and the co-operatives. Out of that conference the following programme, as summarized by the U. S. D. A. publication, "The Facts About Wheat," (7), arose:

It arranged to provide:

(1) A return on that portion of the crop needed for domestic human consumption which will give that portion the exchange value it had in the pre-war period, 1909-14. This portion has been found to be 54 per cent of the average production during the base period, 1928-32.

(2) Agreement of co-operating growers to regulate plantings within limits determined by the Secretary of Agriculture. These limits are designed to provide for domestic needs, adequate reserves, and any likely export demands.

(3) Provision that each co-operating grower should plant at least 54 per cent of his average past acreage, this amount being deemed necessary, with average yields, to meet domestic food requirements.

(4) Financing of the program through a processing tax on the wheat milled for domestic consumption.

(5) Voluntary acceptance of the plan by farmers.

(6) Benefit payments made to co-operative farmers independent of the market proceeds from the sale of their crop, thus providing partial crop-income insurance.

(7) Decentralized administration through county wheat associations.

(8) Co-ordination of the domestic program so far as possible with the International Wheat Agreement.

The effect of this program on farm prices and income was that 368 million bushels of wheat in 1933 brought the United States farmers 365 million dollars, as compared with 524 million bushels bringing them 195 million dollars for the 1932 crop. Out of the 1933 proceeds which the farmers received, 98 million dollars represented benefit payments paid out of the processing tax of 30 cents per bushel on wheat milled. In 1934 a general raise in prices had taken place, and between 270 and 290 million bushels of wheat brought the farmers 270 million dollars plus benefit payments of 101 million dollars, or a total of 371 million dollars altogether.

1934 was the year of the most widespread drought in the United States history, and over 200,000 farmers in the states of South Dakota, North Dakota, Montana, Nebraska, Colorado, Kansas, Oklahoma, Texas, and New Mexico were destitute, not harvesting a single bushel of grain. It was in this instance that the crop insurance feature of the wheat program came into effect with splendid results. Under the terms of the wheat program contract, every farmer who signed it was entitled to a crop income based on past average production, regardless of prevailing crop conditions. In this way, co-operating farmers received their benefit payments regardless of whether the crop was destroyed by drought or other causes. As an example of the value of this contract, the case of South Dakota may be cited. Crop failure was almost complete in this state in the summer of 1933, the total amount of wheat sold by farmers being less than 500,000 bushels, instead of the past four-year average of 37,600,000 bushels. The market value of the wheat sold in 1933 was only $316,000, but under their contracts the farmers were paid an additional $5,000,000, or an amount equivalent to 16 times the market value of the crop produced in that year. Similarly, under the widespread drought of 1934, farmers who were holders of wheat allotment contracts were paid millions of dollars even though their crops had been totally destroyed by drought.

Essentially the wheat program of the AAA is a production control program. It was found that 54 per cent of the average production of the years 1928-32 was needed for domestic consumption, emergency reserve, and possible export needs. This amount was to be given a price value equivalent to the fair exchange value which prevailed between wheat and other commodities in the period 1909-14.

The average total acreage seeded to wheat in the United States in 1930-32 was approximately 66 million acres. Of this amount 78 per cent, or 51,400,000 acres, was brought under contract voluntarily. Growers were authorized to plant 85 per cent of the base acreage for the 1934 crop, or a total of 43,690,000 acres, while the acreage authorized for the 1935 crop was 90 per cent of the base acreage, or 46 million acres.

Wheat-allotment contracts were signed by 800,000 farmers operating nearly 600,000 farms. The program has been on a self-supporting basis from the start, being financed by a processing-tax of 30 cents per bushel on all wheat milled. Provision is made in the Act for varying the processing tax in accordance with prevailing conditions by the clause which states that, "the processing tax shall be at such rate as equals the difference between current average farm price for the commodity and the fair exchange value of the commodity."

The program is controlled by the growers themselves, who are organized into 1,328 production-control associations in 1,758 counties. The county association is the administrative unit for the county, and each association is subdivided into local units who elect their own committees, the chairmen of which automatically become members of the county organization. The farmers themselves pay the costs of the local administration, which are assessed *pro rata* against each bushel of wheat. In 1933-34, this local administrative expense was $4,800,000, most of which was paid to growers serving on local and county committees. In other words, the cost of organizing and administering the program, which was primarily a stabilizing scheme, was about 4½ per cent, a very low insurance premium when it is considered that every farmer in the organization benefited.

The whole attitude of the United States AAA to the problem of stabilizing farm income is very well stated by Chester C. Davis (3), AAA Administrator, when he said, "Leaving the farmer to the mercy of drouth is just as bad as leaving him to the mercy of surpluses. It is *laissez faire* in its crudest, cruelest form." Davis summarizes the effectiveness of the AAA wheat program in meeting a situation like drouth as follows:

"First, it has emphasized from its inception the urgency of getting from grain crops into grass, which is the best protection against wind erosion (dust storms), and for proper land utilization to take sub-marginal areas out of production of useless surpluses and put them into forests, reserves and pastures, which conserve the water resources.

"Second, because the benefit payments are based on average past production, and hence are not decreased by crop failure, it assures co-operating farmers at least a subsistence income, with an opportunity for renewed production next year. Hence, the payments are crop income insurance for the farmer, and insurance of the future productivity of regions which might be depopulated by drouth, preventing recovery of production for years to come.

"It balances and assures the future food supplies of the nation. In this sense, the program happens now in the drouth areas to be, on a long-time basis, the opposite of curtailment, for it assures continued production up to the national needs.

"Third, it sets up the machinery for quick action to buy and utilize large accumulated surpluses of beef and dairy animals or pigs which would perish with great losses, if such machinery did not exist.

"Fourth, it makes it possible to avert for the farmer one of the greatest catastrophes that can happen to him. That is the necessity to take low surplus prices for world crops, when there is little crop to sell, even at the ruinous price. . . .

"The AAA will go ahead on the lines it has planned, adjusting its programs to the emergencies that arise, and striving to do whatever it can to protect farmers from the worst series of emergencies they have ever faced. Reliance on calamity is no substitute for conscious planning and preparation to meet whatever problems arise to face the farmers of this country."

Another plan that has for its purpose the maintaining of what is called the "ever-normal granary" has been established in a number of the states, and it is one that may commend itself to Alberta farmers in the drought area particularly. Briefly, the plan is one which is made possible under the AAA program and the Commodity Credit Corporation, the latter being a subsidiary of the Reconstruction Finance Corporation. The warehouse laws of states taking advantage of the scheme have been amended so as to permit the storing of grain under Government seal on the farm or in bonded warehouses which come up to certain stipulated specifications. Provision is made for Government loans to be made on the security of storage certificates issued for grain under seal.

The scheme has been particularly successful in its application to stored corn in many of the corn-growing states. In the fall of 1933, the price of corn to the farmer was 25 cents per bushel. The Commodity Credit Corporation loaned the farmers 45 cents per bushel on corn sealed in bins, thus in effect pegging the price at that figure. In 1934, this same corn was sold at from 60 to 75 cents per bushel,

with the result that the farmers were able to repay all loans, and make a substantial profit besides.

The States of Oregon, South Dakota, and Kansas particularly have applied the plan to wheat, and a brief outline of the South Dakota scheme will serve to show the way in which the machinery works. The South Dakota Act (8) entitled, "An Act to Provide for Storage of Grain upon Farms, etc., 1935," provides that a group of farmers at least 15 in number shall form themselves into a local association. (Production-control associations under the AAA are used where they exist.) Any person may make application to the State Secretary of Agriculture for the appointment of a supervisory board in and for the community. Board members must all be resident producers of grain within the state. On appointment, the Secretary of Agriculture issues the board a license which prescribes the duties of the board, the records they shall keep and so on. The board then appoints, subject to the approval of the Secretary of Agriculture, a person to act as the local sealer. The sealer is bonded, and is charged with the duty of sealing and supervising grain in storage on farms, and the issuance of negotiable certificates on all grain sealed.

Expenses of the plan are provided for by a charge not to exceed 1 cent per bushel of all grain sealed, payable by the farmer at the time of sealing. Some of the states make a charge of $5.00 per member on application, to which a bushelage charge is also added. The owner of the grain must deliver at the command of the holder of a certificate all or such part of the sealed grain as the certificate calls for. Sealed bins are inspected every 90 days, and persons are subject to fines or imprisonment, or both, for breaking seals.

The foregoing is a brief outline of a plan which is meeting with considerable favour in the States of the Union where it is being tried.

Discussing this plan in a recent issue of the "Annals," Louis H. Bean (1), Senior Agricultural Economist with the U. S. D. A., declares that "a sound storage program and a continuing adjustment program are the two stable legs on which American agriculture can move toward stable prosperity and improvement in rural living standards." Practically all United States authorities are in agreement on the need of the farm storage plan being linked up with some sort of production-control program on a nation-wide basis to be successful.

THE ALBERTA SITUATION IN RELATION TO AN INSURANCE PROGRAM

People who live in Alberta are only too familiar with the tremendous fluctuations which take place from year to year in the yields of grain from district to district, as a result of natural hazards of one kind or another. Unfortunately, accurate and detailed statements of these losses by districts are not available, except in the case of hail losses. A survey of the meagre agricultural statistics that are available for Alberta, shows that every year there are variations in yield from nothing to 40 bushels per acre. The main causes of these variations are undoubtedly hail, drought, frost, plant diseases and insect pests, but, apart from knowing that these hazards are more common in certain districts than others, we know very little about them. Certainly we have no long-time data which is sufficiently detailed to be able to work out the actuarial basis for a system of crop insurance.

The greatest fluctuation in yield takes place in the southern half of the province and some idea of this can be gained from an examination of Table I., which shows the average yield reported for the four major crops of wheat, oats, barley and rye for the period 1921-34 inclusive.

When these yields are multiplied by the price obtained for each commodity, during the same period as that covered in the table, it is possible to get a fair picture of the variation in farm income for a given area.

The first attempt to gather detailed statistics on crop losses by causes and crops was made by the Dominion Bureau of Statistics in the census of 1931. These losses are shown in Table II., while the same losses by causes, crops and census divisions are shown in Table III.

From Table III., it will be seen that 22,786 out of Alberta's total of 97,400 farms suffered crop damage in the season of 1930. In other words, 1,883,546 acres out of a total seeding of 12,500,000 were damaged by one or a number of natural causes in that year. This means that approximately 15 per cent of the total acreage sown was destroyed by natural elements and that 23 per cent of the total number of farmers had their income seriously affected. Of these losses, hail caused 53.7 per cent; drought, 30.5 per cent; wind, 11.7; insects, 1.6; and frost,

1.2 per cent. Plant diseases are credited with less than one per cent but plant pathologists claim that this figure is decidedly low. It is unfortunate that the above information is not available for a decade at least because it would then be sufficient to give a reasonably accurate picture of the long-time situation. However, from a general knowledge of conditions which have prevailed over the past number of years, it can be said that 1930 was not a particularly bad year, in spite of high hail losses—not nearly as bad as the season of 1935. From this it might be assumed that anual crop losses in the province will be in excess of 10 per cent at a very conservative estimate, and in all probability, would be much higher. If a further assumption is made that all of Albertas 12 million acres of field crops are insured at $5.00 per acre (a very low risk) the total risk involved would be $60,000,000. A 10 per cent loss on this total risk would involve the province in an outlay of $6,000,000 for indemnities alone and administrative expenses would be extra. Such a loss expectation would in all probability, necessitate a premium rate of $12 to $15 per $100 of insurance carried.

The experience of the Alberta Hail Insurance Board, which has been functioning since 1919, is interesting because of the light it throws on the loss expectation they have to meet on the comparatively small acreage they insure.

Details of the hail risks and losses are shown in Table IV.

From this table it will be seen that the maximum loss recorded was one of 17.1 per cent in 1927, while the lowest loss was 2.4 per cent in 1933, and the average loss over the sixteen-year period was 8.6 per cent of the total risk. The foregoing figures, scanty and incomplete as they are, when taken in relation to the province as a whole, at least serve to give a general indication of the loss probabilities which any crop insurance organization would have to face.

TABLE I. ALBERTA

AVERAGE YIELD PER ACRE—BUSHELS

CENSUS DIVISION	Wheat Bush.	Oats Bush.	Barley Bush.	Rye Bush.
1921				
1	9	18	16	10
2	15	30	30	28
3	9	16	18	10
4	15	34	24	28
5	7	20	12	12
6	14	34	25	12
1922				
1	8	18	11	7.5
2	16	28	27.5	15
3	8	16	15	7.5
4	15.75	28	27.5	16
5	7	12	6	7
6	12	24	14	10
1923				
1	18	30	23	10
2	25	50	32	22
3	18	30	17	14.5
4	30	50	34	23
5	28	52	27	18
6	35	50	42	24
1924				
1	4	16	8	4
2	12	34	25	10
3	6	22	12	8
4	14	34	26	13
5	7	25	6	6
6	12	30	26	18
1925				
1	10	20	15	7
2	18	29	21	14
3	12	34	30	9
4	20	34	24	12
5	17	30	24	14
6	18	31	27	16

TABLE I—Continued

CENSUS DIVISION	Wheat Bush.	Oats Bush.	Barley Bush.	Rye Bush.
1926				
1	7.5	21	23.5	7
2	18	34	21	11.5
3	11	27.5	30	7.25
4	25	36	22	12
5	16	28	14	13
6	19	30	21	16.5
1927				
1	30	47.75	19.25	21
2	28.5	39.25	31.25	23.25
3	31.25	47.5	43.5	23.5
4	30.25	50	28.5	19.5
5	27.75	43.75	23.75	19.4
6	26	45	27	22.4
1928				
1	27	42	22.75	15.25
2	24.5	36.75	26.25	17.25
3	24.5	39	32.5	15.75
4	24.75	39.75	25.5	16
5	20.75	31.75	25.5	16
6	26.5	41.25	33.25	16.25
1929				
1	13.55	19.48	15.12	10.35
2	21.8	35	30	20.61
3	10.81	25.56	23.94	8
4	15.5	25.16	25	15
5	6.07	7.39	4.52	7
6	9.4	20.48	15.45	19
1930				
1	9.15	18.62	14	7.89
2	21.48	32.10	24.92	21.82
3	10.10	31.05	24.34	6.17
4	22.03	39.19	30.81	13.76
5	9.89	16.06	10.78	12
6	15.04	32.77	18.9	19.11
1931				
1	8	16.5	11.5	5.25
2	15	24.5	19	11.25
3	10	33.5	29.5	5.25
4	16	28.5	19.5	9.25
5	8	20.5	23.5	4.89
6	17	32.5	25.5	12.25
1932				
1	13.22	27	25	8.86
2	24	34	26	15
3	14	33	29	9.50
4	20.5	43	30	12
5	15.5	28	28	7.84
6	26.5	50	28	20
1933				
1	10	17.7	18.9	5.64
2	9	15.66	13.5	6
3	7	22.61	26.5	4
4	9.73	18.74	12.6	5
5	6.5	13.84	19.9	4
6	13.83	22.45	17.9	7
1934				
1	12.3	23	27	8
2	18.7	35	30	16
3	8.9	36	33	5.9
4	16	30	20	10
5	5.6	12	11.9	5
6	14	30	19	16

TABLE II.

ACREAGE OF CROP FAILURE, 1930, BY CAUSES AND BY CROPS—PROVINCE OF ALBERTA.

Cause	Wheat	Barley	Oats	Rye	Hay and Forage Crops	Other Crops	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Alberta	1,342,752	99,558	350,855	41,606	37,291	11,484	1,883,546
Drought	400,208	31,486	98,454	17,657	22,105	5,473	575,383
Frost	8,970	1,151	7,968	1,474	655	1,539	21,757
Hail	757,405	43,365	182,061	16,414	9,197	3,382	1,011,824
Insects	9,051	9,577	11,114	182	697	366	30,987
Plant diseases	117	9	25	—	45	2	198
Rain	2,333	193	4,467	—	646	68	7,707
Rust	156	—	15	—	—	—	171
Wind	155,532	12,960	43,705	5,191	2,651	480	220,519
Other causes	4,492	541	1,916	438	879	149	8,415
Not specified	4,488	276	1,130	250	416	25	6,585

TABLE III.

ACREAGE OF CROP FAILURE, 1930, BY CAUSES—PROVINCE OF ALBERTA, BY CENSUS DIVISIONS

Census Divisions	All Causes	Drought	Frost	Hail	Insects	Plant Diseases	Rain	Rust	Wind	Other Causes	Not Specified	No. of Farms Reporting Failure
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Alberta	1,883,546	575,383	21,757	1,011,824	30,987	198	7,707	171	220,519	8,415	6,585	22,786
Div. No. 1	80,738	58,314	1,064	20,032	100	—	21	—	106	491	610	911
" " 2	19,271	13,008	1,845	2,149	188	112	70	15	413	1,285	186	704
" " 3	80,389	50,072	239	27,400	40	—	373	—	1,962	303	—	827
" " 4	45,414	32,846	594	10,271	198	—	59	—	425	684	337	649
" " 5	428,442	87,158	2,354	306,349	472	—	158	—	29,487	1,230	1,234	3,193
" " 6	384,636	223,349	336	137,762	2,145	—	150	—	19,368	1,051	475	3,159
" " 7	274,703	9,902	5,147	182,016	1,349	—	29	67	73,745	1,363	1,085	3,056
" " 8	351,823	77,792	671	181,752	16,584	7	—	50	73,513	327	1,127	4,785
" " 9	40,689	1,222	82	33,711	4,413	2	—	—	1,097	83	79	1,057
" " 10	114,937	3,818	7,849	87,116	772	42	16	14	14,625	150	535	2,035
" " 11	38,625	16,197	305	14,725	1,326	29	7	—	5,622	136	278	1,003
" " 12	2,196	150	62	1,544	60	—	109	—	2	197	72	126
" " 13	5,913	122	404	2,647	1,997	—	6	—	54	236	447	274
" " 14	5,531	821	357	3,463	199	—	233	25	100	218	115	308
" " 15	5,946	28	59	872	40	6	4,837	—	—	104	—	362
" " 16	4,138	584	379	5	1,083	—	1,617	—	—	465	5	327
" " 17	155	—	10	10	21	—	22	—	—	92	—	10

TABLE IV—HAIL INSURANCE LOSSES 1919-34—ALBERTA HAIL BOARD

	Acres Insured	Total Risk	Acres Damaged	Total Awards	% of Loss to Risk
1919	2,180,518	$ 13,146,050	198,239	$ 503,958	3.8
1920	2,332,081	21,945,067	235,086	881,280	4.0
1921	2,266,736	20,384,106	538,887	2,149,761	10.6
1922	1,570,707	14,097,979	114,701	291,697	2.1
1923	2,248,240	21,208,133	634,115	2,410,870	11.4
1924	958,695	8,736,806	179,142	478,818	5.5
1925	1,148,545	10,886,244	182,458	685,053	6.3
1926	1,139,064	10,780,000	224,560	680,116	6.3
1927	1,550,676	14,769,177	609,563	2,520,041	17.1
1928	1,328,432	12,459,771	378,391	1,546,601	12.4
1929	887,532	7,863,413	121,168	574,220	7.3
1930	1,246,487	11,045,317	418,266	1,768,935	16.0
1931	293,048	1,596,116	70,226	153,650	9.6
1932	452,599	2,394,308	49,122	74,685	3.1
1933	188,171	989,104	13,230	23,391	2.4
1934	255,724	1,344,350	54,673	136,992	10.2
	20,047,255	$173,645,941	4,021,827	$14,880,068	

Average loss, 8.6% of risk.

CONCLUSIONS

From the information presented in this report, it is obvious that any one of three courses are open to the Alberta people. First, to embark on a scheme of state co-operative crop insurance; second, to initiate some sort of planned production control programme in conjunction with the other provinces of Canada, similar to the United States' AAA programme, for the purpose of using its crop insurance features; and third, the launching of a province-wide system of farm storage to carry supplies over from one year to the next.

If the crop insurance plan is followed, it would seem more practicable to cover all crop hazards beyond the farmers' control than to single out drought or any other specified hazard. This eliminates the problem of trying to determine to what extent crop failure, when it occurs, is due to a stipulated meteorologic or other natural hazard and limits the problem to one of ascertaining what yield or income (yield times price) was actually obtained, and whether or not the grower himself had done his part in a proper way. On this plan, which amounts in effect to guaranteeing a minimum return either in yield or in value, the guarantee should be decidedly moderate in order to remove as far as possible all undue reliance upon it, and also with the view of keeping the premium moderate. Six or eight bushels of wheat or its equivalent in other crops or, if the guarantee is in dollars, not more than $5.00 or $6.00 per acre should be the outside limit of insurance.

The lower the guarantee per acre, the fewer insurance losses to be compensated for, and the smaller the margin to be made up in cases where indemnity is due.

The second proposal could not be carried out by a single province but might be initiated on a Dominion-wide basis, possibly using such facilities as the Canadian Wheat Board. Such a plan would make for a planned production as long as sufficient safeguards were introduced to prevent an expansion of acreage. These safeguards are provided through the feature which necessitates the signing of a contract agreeing to abide by the acreage allotment before becoming eligible for crop-income benefits. The scheme would provide income based on the average of past performance. The plan might be financed by a processing tax, as in the United States, having in mind that a much smaller percentage of Canada's wheat is processed within Canada than is the case in the United States.

The third and last plan of sealed farm storage is within the power of the province to initiate without dependence on outside agencies providing a loaning organization is set up which would loan money on the security of storage certificates. This plan if adopted even on a small scale, would make it possible in the dry areas from one year to the next at a very moderate cost, and would in all probability, be much cheaper for the government than the present plan of shipping in

seed and feed relief. Another advantage of this plan which should not be lost sight of, is its usefulness as a means of reducing the wheat surplus. There is no question but what much more wheat would have been used in the last few years if it had been actually available on the farms in the dry areas instead of having to be shipped in.

Although it is possible for the province to initiate a farm storage plan which would provide a measure of crop insurance and would reduce the cost of relief it is undoubtedly true that the scheme would be more effective as part of a national wheat program.

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REFERENCES

1. BEAN, LOUIS H., Planning our 1935 farm program, The Annals, Nov., 1934.
2. BLACK, JOHN D., Research in agricultural insurance, Bulletin 14, Social Science Research Council, New York City, October, 1932.
3. DAVIS, CHESTER C., Contract acres aid in drought, Wallace's Farmer, June 9, 1934.
4. HOFFMAN, G. WRIGHT The outlook for crop insurance, The Annals, March, 1929.
5. HOFFMAN, G. WRIGHT Insurance for agriculture, The Annals, May, 1932.
6. VALGREN, V. N., Crop insurance: risks, losses and principles of protection, U.S.D.A. Bulletin 1043, January, 1922.
7. THE FACTS ABOUT WHEAT, Wheat Circular 1, Agricultural Adjustment Administration, Washington, D. C., Jan., 1935.
8. SOUTH DAKOTA LAWS relating to farm storage of grain, South Dakota, Department of Agriculture.